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A HANDBOOK

OF THE

BRITISH LICHENS

WITHDRAWN

BY

ANNIE LORRAIN SMITH, F.L.S.

WITH NINETY FIGURES IN THE TEXT

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INTRODUCTION

THE LICHEN-PLANT.

LICHENS are a class of thallophytes of lowly organization that inhabit soil, rock, wood, trees, etc. The vegetative thallus is of varying form and colour; the reproductive organs are akin to those of fungi. They differ from all other members of the vegetable kingdom in their composite structure, being formed from the union in intimate symbiotic relationship of two separate plants, a fungus and an alga. This can easily be demonstrated in any part of the thallus or vegetative structure; a thin section, examined under the microscope, shows a ground structure of colourless cells or hyphæ, the fungal elements; and a series of green cells which are the algæ. If the latter are confined to a narrow zone near the upper surface, the thallus is termed heteromerous (see figs. 5, 6), but if they are scattered more or less evenly through the thallus it is then described as homoiomerous (fig. 1).

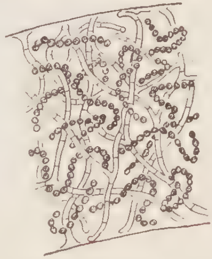

FIG. 1.—Section of homoiomerous thallus of *Collema*. × 250.

This old division of lichens into heteromerous and homoiomerous does not entirely correspond with the modern more exact system of classification based on the reproductive organs; but the type of structure thus indicated is generally well marked, and a valuable character in identification.

Fungal elements of the thallus. These have undergone considerable modification as lichen constituents, and cannot as a rule be traced back to any particular species or genus of fungi. The British lichens, however, are all associated with Ascomycetes, and approximate to certain groups within that class of fungi. In the tropics there are lichens in which the fungus belongs to the Hymenomycetes.

Lichen-hyphæ, as they issue from the germinating spore and lay hold on the algæ, are thin-walled, and similar to those of fungi (fig. 2). The various tissues are formed by the branching and septation of these hyphæ. In the growing regions, at the apex or edges of the thallus, or in the gonidial region, the cells remain comparatively thin-walled; but in the other parts of the thallus, especially in the medulla, the walls become very thick, with the exception of the gelatinous lichens, in which the thickening is less marked. In the cortex of the foliose and other species, there is frequently a formation of pseudo-parenchyma (plectenchyma). It arises from the vertical, multiseptate tips of the hyphæ which lie closely packed together and present the appearance of cellular structure. In many cortices, more especially of crustaceous lichens, the walls are so swollen that the cell-lumen practically disappears and the tissue becomes an amorphous gelatinized mass.

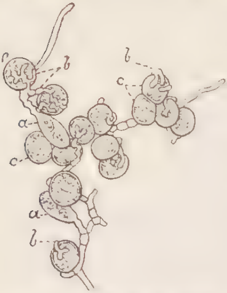

FIG. 2.—*a*, Germinating spores; *b*, clasping filaments; *c*, algal cells. (After Bonnier × 350.)

Strengthening elements are provided by the coherent parallel growth of thick-walled hyphæ which form fibre-like bundles or chondroid strands that give support to the thallus.

Lichen-hyphæ retain many of the characteristics of those of the higher fungi. Pure cellulose has not been found, the cell-walls being formed of various hemi-celluloses, and nearly all the cell-membranes contain more or less chitin. The cells enclose a nucleus, protoplasm, glucoses and sometimes oil-drops; glycogen occurs in the cells of the reproductive system. Sphæroid cells filled with greenish oil are a constant feature of the lower rhizoidal layer of calcicolous lichens; oil cells also occur occasionally in other lichens.

Algal elements of the thallus.—The algal constituents of the composite thallus belong to the two classes—(1) Myxophyceæ, generally termed blue-green algæ, and (2) Chlorophyceæ, which are referred to as bright green. Most of them are aerial forms and, in a free condition, they inhabit moist shady situations. They multiply by division within the thallus; zoospores are never produced except in cultivation outside the thallus. *Chlorella* which resembles *Protococcus* in form and size has been proved recently * to be the gonidium of many of our common lichens. It increases within the thallus by the formation of aplanospores in the mother cell. The sporulation stage is evident at times of special growth in spring or in rainy weather following a dry season. The determination of the genera and species to which the algæ severally belong is often uncertain, but their distribution in British lichens is somewhat as follows:—

1. Myxophyceæ associated with Phycolichenes, many of them gelatinous lichens (fig. 3). They are:—

Scytonema occurring in *Thermutis*, *Spilonema*, *Leptogidium*, *Gyalecta* (in part), *Placynthium*, *Polychidium*, *Porocyphus* and *Coccocarpia*.

Stigonema in *Ephebe* and *Ephebeia*.

Glœocapsa in *Euopsis*, *Pyrenopsis*, *Synalissa* and *Psorotichia*.

Nostoc in *Collema*, *Leptogium*, *Peltigera*, *Pannaria* and *Parmeliella*.

Rivularia in *Lichina* and *Pterygium*.

Nylander gave the name gonimia to the blue-green algæ of the thallus, retaining the term gonidia for the bright-green species. The distinction is not generally maintained.

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* Paulson & Hastings in Journ. Linn. Soc. xliv, pp. 497–506, 1920.

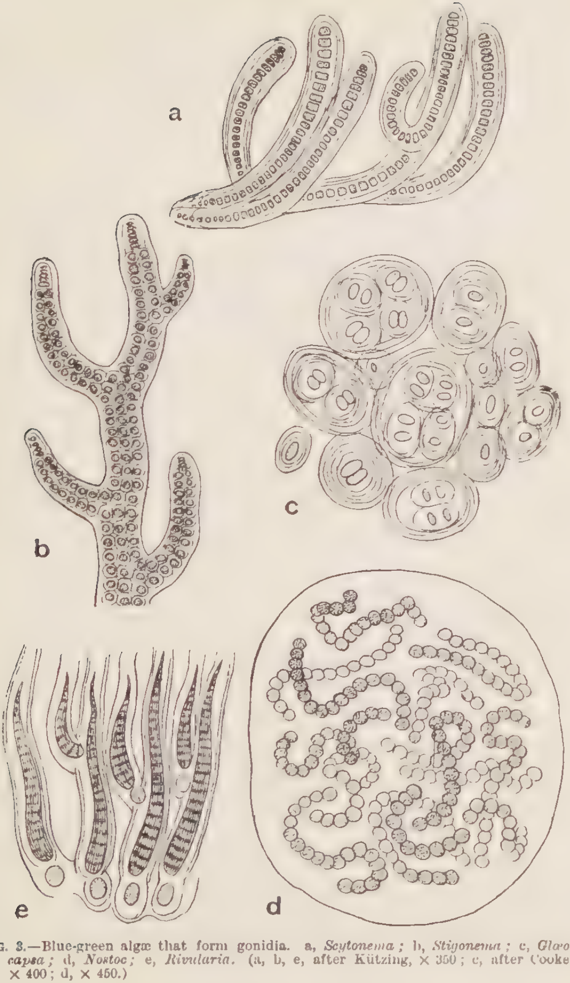


FIG. 3.—Blue-green algæ that form gonidia. a, *Scytonema;* b, *Stigonema;* c, *Glœocapsa;* d, *Nostoc;* e, *Rivularia.* (a, b, e, after Kützing, × 350; c, after Cooke, × 400; d, × 450.)

2. Chlorophyceæ associated with Archilichenes (fig. 4) as follows:—

Protococcus (Cystococcus, Pleurococcus) or probably only **Chlorella** and **Palmella** in the greater number of the larger lichens and in many crustaceous genera, such as *Lécanora*, *Lecidea*, *Pertusaria*, *Verrucaria*, etc.

Trentepohlia in *Cœnogonium*, *Dirina*, *Roccella*, *Graphidaceæ*, *Pyrenulaceæ*, and also in *Thelotrema* and *Gyalecta*, rarely in *Lecanora* and *Lecidea*.

Cladophora in *Racodium*.

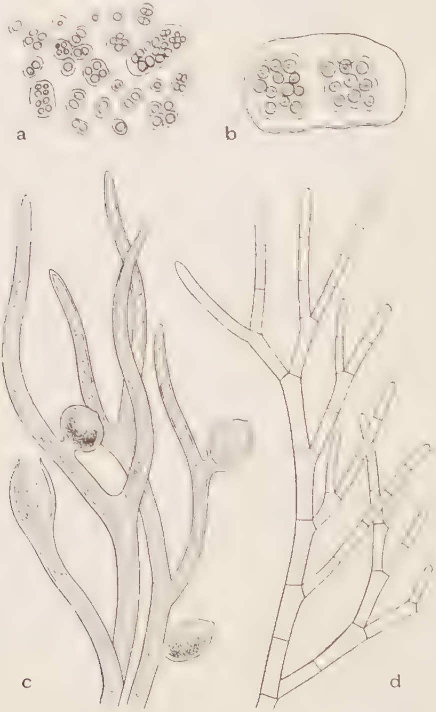


FIG. 4.—Bright-green algæ that form gonidia. a, *Protococcus*; b, *Palmella*; c, *Trentepohlia*; d, *Cladophora*. (a, b, × 250, after Hassal; c, after Cooke, × 250; d, after West, × 60.)

Though as a general rule the alga is less affected than the fungus by the symbiotic life, it also may become modified in appearance. The blue-green forms may lose their colour, as in *Glœocapsa;* or the strings of cells may be broken up, as occasionally in *Nostoc*, *Scytonema*, etc. Among the Chlorophyceæ, there is occasional change of form both in *Protococcus* and in *Trentepohlia;* they revert to their original appearance in free cultivation.

MORPHOLOGY.

There are three principal types of development in the vegetative body or thallus of lichens:—

1. *Crustaceous*, or encrusting lichens which spread over trees, rocks or soil, with a more or less well-developed crust varying in thickness, form and colour. The thallus consists generally of an upper cortical layer of hyphæ; beneath the cortex a zone of algal cells and lower still a medulla of fungal filaments, the latter resting directly on the substratum; sometimes the crust is only a thin structureless mixture of hyphæ and algæ. Though mostly superficial the crustaceous thallus is, in certain genera or species, partly or wholly embedded in the bark or rock on which it grows. It is thus often difficult to recognize the different tissues. The lower hyphæ in many of the superficial species form a thin spreading layer called the hypothallus; it is usually dark in colour and often appears as a black border to the thallus, either as a firm limiting line or as dendritic filaments. A patch of crustaceous lichen on tree or rock may belong to one species and yet be composed of many individuals which have started from different centres, each growing centrifugally. The dark lines chiefly occur where the different individuals encounter each other. A striking instance of such intersecting lines occurs in the thallus of the well-known *Rhizocarpon geographicum*. Strong boundary lines also frequently divide different species inhabiting the same substratum.

2. *Foliose, foliaceous or leafy lichens:* as the name implies, these are spreading leaf-like expansions of one or many lobes, which adhere more or less firmly to the support on which they grow. Like the crustaceous forms, they are dorsiventral in structure; the upper surface is provided with a distinct hyphal cortex, beneath which lies the gonidial zone and the medulla. There is also a lower cortex which is frequently of a darker colour and which is mostly provided with hairs or with rhizoids formed of strands of hyphæ that are chiefly organs of attachment.

3. *Fruticose or shrubby lichens:* these are upright branching forms rising from a basal point, and they are either cylindrical or strap-shaped. The structure is radial, with a central pith of fungal hyphæ, a surrounding band of algæ and an outer cortex of fungal elements. There is considerable variety of form in this group from the short, stiff, strap-shaped lobes of some *Ramalinæ* to the long pendulous thread-like strands of *Alectoria* or *Usnea*. Intermediate forms connect these different groups. In the Cladoniaceæ there is a basal thallus, either crustaceous or of small lobes, and there is also an upright stalk called a "podetium," which in many cases opens out into a cup-like structure called a "scyphus." The podetia may be simple or branched, and as the reproductive bodies in this family are borne on the tips of the branches or on the edges of the scyphi, the upright thallus has been frequently regarded as a modified fruit-stalk.

VEGETATIVE STRUCTURES PECULIAR TO THE LICHEN-THALLUS.

Soredia.—These are small powdery bodies that consist of one or several algal cells closely surrounded by lichen-hyphæ. They occur as greyish powder on trees, or on the ground, representing the first stage of thallus formation; as white or greyish granules on the squamules and podetia of many Cladonia, or they are massed on the surface of the thallus into well-defined pustules called soralia. The soralium is formed by an increased growth of soredial gonidia and hyphæ at certain points within the thallus, the overlying tissue finally bursting and allowing the escape of the soredia. Soralia are generally constant in form and in position on the thallus. Each soredium can give rise to a new lichen-plant. It is a method of vegetative reproduction that secures a ready and wide dispersal of species.

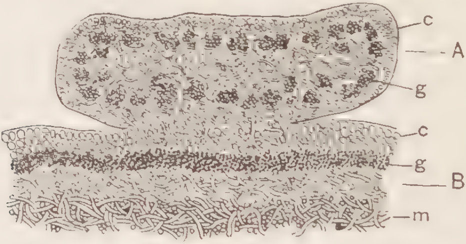


FIG. 5.—Vertical section of thallus and cephalodium of *Peltigera aphthosa*. A, Cephalodium; B, Thallus. c, cortex; g, gonidia; m, medulla. (Greatly magnified.)

Isidia. The isidium is a small outgrowth from the surface of the thallus which contains both the algal and fungal constituents, but differs from the

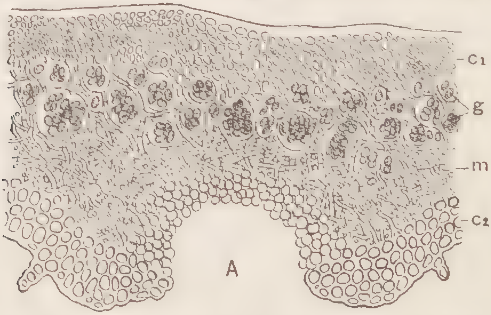


FIG. 6.—Vertical section of heteromerous thallus and cyphella of *Sticta* sp. A, Cyphella; c_1, upper cortex; c_2, lower cortex; g, gonidia; m, medulla. (Greatly magnified.)

soralium in being covered by a cortex. Usually the isidia are like minute cones on a narrow stalk; occasionally they are branched.

Cephalodia. On the thallus of various lichens there are developed abnormal, and generally darker-coloured swellings, tubercles or warts, composed of the normal lichen hyphæ, but containing a different algal constituent, which is almost invariably one of the Myxophyceæ (*Nostoc*, *Stigonema*, etc.). Cephalodia are constant in form and occur as flat orbicular light-coloured expansions (*Lecanora gelida*), groups of dark branchlets (*Lobaria laciniata*), or irregular warts (*Peltigera*, *Stereocaulon*). They also form internal packets in certain species, which are termed endotrophic cephalodia. They are probably of value in retaining moisture (fig. 5).

Cyphellæ and Pseudo-cyphellæ.—These are small roundish bodies scattered over the lower surface, mostly in the genus *Sticta*. They are of definite form with a distinct rim (cyphellæ), or they are mere openings in the cortex through which hyphæ project (pseudocyphellæ). They serve most probably as aerating organs as do the bare areas on the under surface of *Lobaria pulmonaria*, etc. (fig. 6).

Definite breathing pores have been demonstrated in only one lichen, *Parmelia exasperata*; but openings and breaks occur frequently and allow ready communication between the internal tissues and the outer air.

REPRODUCTIVE ORGANS.

Apothecia and Perithecia.—With the exception of a few tropical genera of Hymenolichenes, all known lichens belong to the subclass Ascolichenes and produce their spores in fruits—apothecia or perithecia—somewhat similar to those of the Ascomycetes.

Apothecium.—An open fruit with a more or less exposed disc, comparable to that of the Discomycetes among fungi. The simplest type of apothecium is formed solely from the fungal constituent as in the Lecideaceæ, usually a round button-like disc, which is either soft and often brightly coloured (biatorine) (fig. 8), or dark and mostly hard and carbonaceous (lecideine) (fig. 7). The disc is formed of compact upright rows of asci or thecæ (a) which contain the spores, and of simple or branched sterile threads,

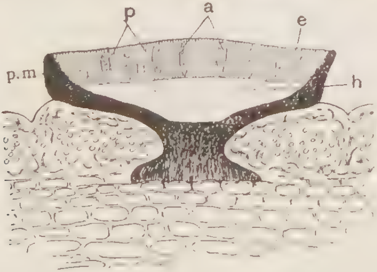


FIG. 7.—Vertical section of lecideine apothecium. a, asci; p, paraphyses; e, epithecium; h, hypothecium; p.m, proper margin. (Greatly magnified.)

the paraphyses (p), of which the tips generally project beyond the asci and form the epithecium (e). The combined asci and paraphyses are the hymenium. The tissue of the fruit immediately below the hymenium is the hypothecium (h), and as continued up and round the fruit is called the parathecium or "proper margin" (p.m). It may be formed of loosely interwoven light-coloured hyphæ, or it may be dark and carbonaceous. Frequently it is excluded by the growth of the disc (fig. 8).

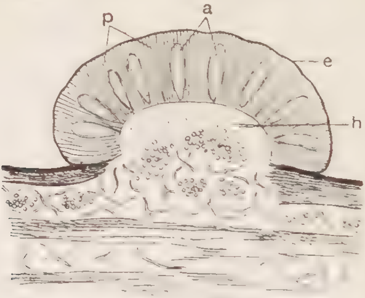


FIG. 8.—Vertical section of biatorine apothecium. a, asci ; p, paraphyses ; e, epithecium ; h, hypothecium. (Greatly magnified.)

In the more highly developed lecanorine apothecium (fig. 9) the thalline tissue containing gonidia develops along with the other apothecial tissues. This outer protective wall or amphithecium is generally called the "thalline margin" (th.m) ; it closely surrounds and forms an integral part of the

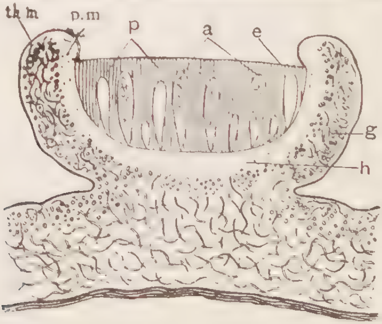


FIG. 9.—Vertical section of lecanorine apothecium. a, asci ; p, paraphyses ; e, epithecium ; g, gonidia ; h, hypothecium ; p.m, proper margin ; th.m, thalline margin. (Greatly magnified.)

apothecium. Apothecia vary greatly in size from about 0·25 to 10 mm. or more in diameter.

Perithecium. When the fruit is a closed body with only a narrow opening or ostiole it is called a perithecium (fig. 10). Generally it is surrounded by a wall and the perithecium is then entire (a), or the wall is absent or reduced to a thin line below the base and it is then described as dimidiate (b). Perithecia are always small bodies and usually they are partly immersed in the thallus or substratum.

As a rule lichen-fruits grow slowly. Spores may be produced almost any time in the year, but for a number of species there is a double spore-bearing season, in spring and again in autumn. The same fruits often persist for several years, new asci being continually formed. It is therefore no unusual experience to find the spores shed in seemingly well-fruited lichens.

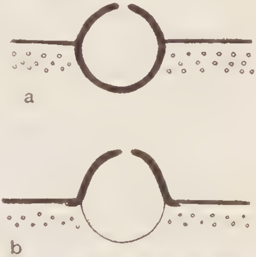


FIG. 10.—Vertical section of perithecia. a, entire; b, dimidiate (Greatly enlarged, diagrammatic.)

Lichen spores vary considerably in size, form, septation and colour. Usually there are 8 in the ascus, but in some genera or species the ascus contains only one large spore, in others they are innumerable and of small dimensions. The largest spores are found in *Pertusaria* and in *Varicellaria*, the 1-septate spore of the latter measuring up to 350 μ × 115 μ. In the family, Physciaceæ, the cross wall of the septate spore is so thickened that the lumen of each cell is reduced to a small area at the ends; hence the term polari-bilocular. This is a type of spore without any parallel among fungi. Each cell of a septate spore may give rise to a hyphal filament on germination. The large one-celled spores of *Pertusaria* and other lichens contain many nuclei and produce germinating tubes all over the surface (fig. 11). The newly formed hyphal filaments become associated with an algal cell, and development proceeds (fig. 2), or, if no alga is encountered, the hyphæ in time die off. In some genera of Pyrenocarpaceæ (*Endocarpon* and *Staurothele*) gonidia occur in the hymenium alongside of the asci. They escape from the perithecia with the spores, and together they build up a new plant.

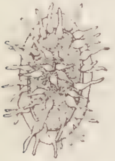


FIG. 11.—Multi-nucleate spore of *Lecidea sanguinaria* var. *affinis*, with germinating tubes. (After de Bary. × about 250.)

Spermogones or Pycnidia.—These are small perithecia-like bodies which occur on many lichens, generally scattered over the thallus, but occasionally confined to definite areas: to the periphery of the lobes (*Parmelia physodes*), the margins (*Cetraria islandica*) or the tips of the podetia (*Cladonia*). They vary in form, being ovoid, globose, etc., and sometimes irregular, with folds of tissue projecting inwards thus subdividing the interior. The inner wall is lined by simple or branched hyphæ, the sterigmata, or by a cellular tissue on which spermatia are borne. The spermatia are usually minute, and more or less cylindrical, and are provided with a cell-wall and contain a nucleus, etc. Many lichenologists have looked on these bodies as the male organs of the plant bearing non-motile spermatia. They are largely functionless, and as germination of the "spermatia" has been observed in a number of forms, it seems probable that they should rank as secondary fruit forms or pycnidia, their contents would then be more properly described as sporophores and pcynidiospores.

The form of the sterigmata (or sporophores) varies, and the differences have been made use of in classification. Nylander divided the spermogones into two groups: those with simple "sterigmata" and those with "arthrosterigmata." In the former, the more usual type, the sterigmata are more or less upright, variously branched, and sometimes anastomosing; they are usually sparingly septate, and the spermatia are acrogenous on the tips of a secondary branch. The arthrosterigmata are divided up into short cells, each cell directly giving rise to a pleurogenous spermatium (or spore). This type of sterigma is found in *Physcia* and *Sticta*. In *Endocarpon* the arthrosterigmata form a tissue lining the wall.

The spermatia also show great variation in form. Usually they are extremely minute, or if elongate, extremely narrow and thread-like. Some undoubted pycnidia contain larger stouter spores which do not differ from the others except in size, though the term "pycnides" was wholly reserved for these by Lindsay.

PHYSIOLOGY.

Nutrition.—In the higher plants there are green cells containing chlorophyll and colourless cells forming tissues with different functions. We find the same distinctions between the tissues in lichens, but with this great difference, that whereas, in the higher plants, all the cells have the same initial starting point, in lichens, the two kinds of cells have a widely separate origin. In lichens, as in the higher plants, the green cells—the lichen gonidia—do the work of assimilation and by photosynthesis prepare carbohydrates for the whole plant. The colourless cells or hyphæ are the organs of absorption, and, in return for the algal carbohydrates in the form of sugars or glucoses, they supply water, nitrogenous substances and salts, which they have absorbed from the substratum or from the environment and converted into a state in which they can be used by the protoplasm of the green cell.

Symbiosis.—The relationship between the two organisms was at first regarded as that of algal host and fungal parasite, but further consideration showed that this view was not entirely satisfactory, and Reinke pointed out that each member of the joint thallus might be regarded as the "consort" of the other. This view was further elaborated by de Bary, who brought forward a similar theory of "*symbiosis*," or conjoint life with more or less advantage to each member or *symbiont* of the dual organism. The alga undoubtedly grows with great vigour in the lichen-thallus, being excited to increased vitality by contact with the fungus, or by conditions, such as increased moisture, supply of inorganic salts, shelter, etc., that are specially favourable to its growth. On the other hand, the fungus withdraws from the alga the necessary carbohydrates. The presence of hyphæ within the algal cells observed in certain lichens, and of empty algal membranes in others, testify to the occasional harmful ravages of the fungus; but any theory of lichens as merely parasitic fungi is incompatible with the continuous healthy development of the lichen plant.

Excretory products.—In many lichens there is an abundant formation of oxalate of lime; it is laid down in crystals on the outside of the hyphæ, medullary or cortical. In *Lecanora esculenta*, a limestone desert lichen, it has been proved that the crystals form sixty per cent. or more of the dry substance of the thallus.

There is also an enormous production of lichen acids, organic products of varying chemical formulæ found only in lichens, and due undoubtedly to the peculiar symbiotic relationship of fungus and alga. Among the best known are parietin (chrysophanic acid), which gives the brilliant yellow colour to several lichens, and the valuable series of acids that produce the orchill of commerce, called also cudbear and litmus. Orchill provides a beautiful purple dye, and though it can be extracted from a number of lichens, the chief commercial source is *Roccella tinctoria* which grows in great abundance on the rocky coasts of southern Europe. The crustaceous lichen *Lecanora tartarea* also yields a purple dye.

ECOLOGY AND DISTRIBUTION.

Lichens are xerophytic in structure and well-adapted by their composite nature to withstand extreme drought and extreme weather conditions. In some cases water may be absorbed from the soil, but in most lichens the habitat precludes that possibility: they live nearly always in xerophytic conditions—on the bark of trees, on the bare rock, on acid moorland soil, on sandy wastes or by the seashore. The hyphæ swell up and retain for a long time the moisture they receive mostly from mist or rain. There is no regular provision for transpiration except in a few cases. Growth is extremely slow, and there is in consequence little demand on the metabolic activity of the cells. A plant of *Parmelia saxatilis* kept under observation for a considerable period was observed to increase about 1 cm. in diameter in a year. The gonidial layer is usually several cell-rows below the surface and is often obscured by pigments in the cortical cells; they require therefore abundant light and pure air, and are always most luxuriant in well-lighted situations, such as the sunny side of a wall, and on the outskirts of a wood rather than in its shady glades. They soon die out or lead an impoverished existence in the near precincts of a large town, owing to the smoke. They are the most cosmopolitan of all plants and the pioneers of vegetation, occupying great tracts of mountain and arctic regions where no other plants can live. Distribution in the case of some genera and species is limited by climate or by the nature of the substratum. On the other hand, there are species, like the mountain-loving *Rhizocarpon geographicum*, that spread almost from pole to pole.

ECONOMIC USES OF LICHENS.

In addition to their use as dye-plants, lichens are to a very limited extent valuable as a food supply. The lichenin stored in the cell-walls of *Cetraria islandica*, the Iceland Moss, can be so prepared as to be both nutritious and appetising and has been often utilised by northern peoples. Species of *Gyrophora*, "tripe de roche," have been eaten by travellers when no other food was available, but though they contain some nourishment they are too bitter for consumption. Reindeer pasture largely on *Cladonia rangiferina*, and snails, slugs, mites, etc., devour eagerly many different kinds of lichens.

In the economy of Nature a considerable part is played by crustaceous saxicolous lichens in breaking up the rock and preparing it for plants more dependent on loose soil. Calcareous and granite rocks are thus slowly but gradually disintegrated. Volcanic rocks with their smoother harder surface are less affected. Topographically as well as geographically, lichens are indispensable pioneers. Many lichens grow on trees, where they are epiphytic, though occasionally their root-bases penetrate the living tissue; only one species, a leaf-lichen in the tropics, has been recorded as constantly parasitic. Sometimes the growth of leafy and shrubby forms is so luxuriant as to cover the entire bark and thus impede the aeration of the tree. On the other hand, it is suggested that they probably protect the tree from extreme cold. They do, however, indirect harm by providing harbourage for insect pests.

PHYLOGENY AND CLASSIFICATION.

Lichens as regards both their symbionts are polyphyletic in origin, the algæ which form gonidia belonging to widely separated groups, and the fungi which form lichen-hyphæ being derived from the two great subclasses Basidiomycetes and Ascomycetes.

All the British lichens are derived from the Ascomycetes, and they are again polyphyletic within the subclass. They fall into two great series:—

I. Gymnocarpeæ, in which the fruits have more or less open discs.

II. Pyrenocarpeæ, with closed fruits.

Series I. The Gymnocarpeæ are divided into three subseries: –

1. Coniocarpineæ, characterized by a "mazædium" type of fruit, and, in most of the families, by a primitive thallus. The derivation is doubtful.
2. Cyclocarpineæ, with open fruits corresponding to those of the Discomycetes. Their fungal ancestors are to be sought for among the Pezizineæ and most probably in the family Patellariaceæ.
3. Graphidineæ. The fruits are characterized by a narrow generally elongate disc. The nearest allies among fungi are the Hysteriaceæ.

In the arrangement of the various Orders or families, special attention has been given to the development of the lichen-plant as a whole within each series.

The Coniocarpineæ are a subseries apart, intimately connected with fungi and have been placed first. The almost closed form of the fruit suggests, however, affinity with the Pyrenocarpeæ.

In the Cyclocarpineæ, the first group includes those families in which the fruit is highly developed, the apothecia with few exceptions having a thalline margin (lecanorine). The lichens containing blue-green algæ (Myxophyceæ) have been considered first; those with a simple homoiomerous thallus being followed by those with a heteromerous thallus, reaching the highest development in the Peltigeraceæ and Stictaceæ, which include genera with both types of gonidia, blue-green and bright-green.

To avoid any break in the arrangement, the Parmeliaceæ, which are allied to the Stictaceæ, are placed next. The gonidia in this and the following families are bright-green. Then follow the Usneaceæ, and after that family the Physciaceæ, marked by the peculiar polarilocular spores. The genera of Physciaceæ range from fruticose to crustaceous forms. The Lecanoraceæ and other crustaceous families close the first group.

The second group (Cyclocarpineæ) includes those families in which the apothecia are without a thalline margin (biatorine or lecideine), the gonidia taking no part in the formation of the fruit: they are thus more primitive phylogentically than the preceding. Beginning with the highest families of the group, we place first the Gyrophoraceæ with a well-developed foliose thallus, followed by the Cladoniaceæ, the filamentous Cœnogoniaceæ—very poorly represented in northern countries—and finally the great family of Lecideaceæ with a crustaceous or, at most, minutely squamulose thallus.

In subseries Graphidineæ, the families have a crustaceous thallus, with the exception of Roccellaceæ, which is fruticose and highly developed, the gonidia are all Chlorophyceæ and mostly from the genus *Trentepohlia*. The arrangement depends on the character of the fruit.

Series II. Pyrenocarpeæ.—There is a small family of Pyrenidiaceæ with blue-green gonidia (Myxophyceæ), the others all contain Chlorophyceæ. There is one family, Dermatocarpaceæ, which is foliose, the other families are all crustaceous and are arranged according to perithecial characters. They are derived from the Pyrenomycetes.

The metric system has been used for measurement; the Greek letter μ indicates the one-thousandth part of a millimeter. Other abbrevations which refer to chemical reagents are as follows: + a colour reaction, f + a faint reaction, – no reaction. Iodine solution (I) iodine 1 grain, potassium iodide 3 grains, water ½ oz., is used as a test for starch or glycogen; potassium hydrate (K) caustic potash and water, calcium hypochlorite or bleaching-powder (CaCl or simply C)—1 part in half its weight of water, and Nitric acid (NO$_3$) indicate by colour-reactions the presence of lichen-acids in the thallus. Thus K + y indicates a general yellow reaction; K followed by C frequently gives a reaction and is expressed as:—K(C) +. The meaning of these varying reactions is that the colour of the acids is liberated by the application of an alkali alone, by bleaching-powder alone or after previous treatment with an alkali. Reactions cannot always be relied on, as the production of acids may have been inhibited by absence of light, etc.

The arrangement of species according to habitat is more or less artificial, as not a few grow on several substrata. Cross references are given to avert risk of mistakes in determination. The numbering of the species refers to the numbers in the Monograph of "British Lichens." Missing numbers are those of imperfectly known species. Descriptions have been severely curtailed in order to keep within the limits of a "Handbook."

LIST OF ABBREVIATIONS

Apo., Apothecium.

Aren., Arenaceous (sandstone), etc.

Cal., Calcareous (limestone, mortar).

Colour reactions.—cr., crimson; o., orange; p., purple; y., yellow.

Distribution.—C., common; F., frequent; S., scarce; R., rare.

Epi., Epithecium (generally tips of the paraphyses).

Hypo., Hypothecium.

Med., Medulla.

Mod., Moderate- or medium-sized.

Paraph., Paraphyses.

Peri., Perithecium.

Pod., Podetium of Cladoniaceæ.

Reagents.—C, Calcium hypochlorite; K, potash; I, iodine; NO_3, nitric acid; (followed by + or −).

Scy., Scyphus of Cladoniaceæ.

Sil., Siliceous rock

Sp., Spore.

Sq., Squamule, squamulose.

Th., Thallus.

CLASS LICHENES.

SUBCLASS ASCOLICHENES.

Series I. GYMNOCARPEÆ.—Fruit a more or less open apothecium.

Series II. PYRENOCARPEÆ.—Fruit a closed perithecium.

SERIES I. GYMNOCARPEÆ.

Subseries I. CONIOCARPINEÆ.—Apothecium partially closed; spores, when mature, a powdery mass (*mazædium*).

Subseries II. CYCLOCARPINEÆ.—Apothecium with open disc; spores ejected when mature.

Subseries III. GRAPHIDINEÆ.—Apothecium with elongate narrow disc (*lirella*); or roundish (*ardella*); spores ejected when mature.

Subseries I. *CONIOCARPINEÆ.*

Thallus crustaceous, wanting, or fruticose (foliose in some foreign genera). Algal cells Chlorophyceæ. Fruit a stalked or sessile apothecium or capitulum, open or partially closed; asci usually cylindrical, dissolving early, the spores, as they mature lying loose in the apothecium, like powder or dust, forming a *mazædium*.

The Coniocarpineæ are distinguished from all other lichens by the peculiar character of the mature fruit. Species in which the thallus has become obsolete have been included by some botanists in fungi, but British species have all been retained among lichens, as they so evidently belong to one series.

Thallus crustaceous	I. Caliciaceæ
Thallus foliose or fruticose..................	II. Sphærophoraceæ.

FAMILY I. CALICIACEÆ.

Thallus effuse, thin, granular-crustaceous, often obsolete. Algal cells Protococcaceæ. Fruit usually a stalked apothecium, top-shaped or globose (capitulum), the stalk, simple or sometimes branched, without gonidia;

paraphyses thread-like; the spores forming a mazædium, simple or septate, mostly dark-coloured.

The fruits are small, mostly stalked and dark in colour resembling minute nails. In one genus, *Cyphelium* (*Trachylia*), they are sessile and marginate, but are easily recognized as coniocarpous by the dark powder, mazædium.

Thallus wanting. Apothecia parasitic.
Apothecia shortly-stalked, top-shaped .... 1. **Sphinctrina.**
Thallus granular-crustaceous, sometimes obsolete.
Apothecia stalked.
Spores spherical, simple.
Dark in the mass .... 2. **Chænotheca.**
Yellow in the mass .... 3. **Coniocybe.**
Spores oblong, septate, dark.
1-septate.. 4. **Calicium.**
3- or more-septate .... 5. **Stenocybe.**
Apothecia sessile, with thalline margin.
Spores oblong, 1- or more-septate, dark .... 6. **Cyphelium.**

1. **SPHINCTRINA** Fr.—Thallus none. Apothecia small, top-shaped, sessile or shortly stalked, black, somewhat shining, with a thick connivent proper margin almost closing the disc; asci subpersistent; spores simple, rarely 1-septate, blackish.

Mostly parasitic on the thallus of *Pertusaria* or other lichens. *S. microcephela* (*S. anglica*) in our specimens occurs on old rails, etc., probably on disappearing lichen thalli.

On *Pertusaria communis*. C. .... 1. **S. turbinata** Fr.
On *Pertusaria melaleuca*, *P. fallax*, etc. R. ... 2. **S. tubæformis** Massal.
On *Lecanora parella* and *L. nitens* on maritime rocks. R. .... 3. **S. kylemoriensis** Cromb
On pines and on rails, in shady places. R....... 4. **S. microcephala** Koerb.

2. **CHÆNOTHECA** Th. Fr. (*Cyphelium* Ach.).—Thallus granular pulverulent or evanescent. Apothecia stalked, top-shaped or subglobose small, dark, often finely powdered, with a greyish or yellow pruina; spores globose or subellipsoid, simple dark, mostly minute.

Mostly on dead wood or on the trunks of old trees.

Apothecia black, yellow-pruinose. Th. various.
Th. bright-yellow, thickish. F. .... 1. **Ch. chrysocephala** Th. Fr.
Th. grey or olive-brown. R. .... 2. **Ch. trabinella** A. L. Sm. (*Ch. phæocephalum* Th. Fr.)
Th. grey, thin; sporal mass protruding. R. 3. **Ch. aeicularis** Zwackh.
Apothecia black or brown, greyish-pruinose.
Th. greyish, thin. S. .... 4. **Ch. trichialis** Th. Fr.
Th. greyish-green, powdery. R............. 5. **Ch. æruginosa** A. L. Sm.
Apothecia brown, not pruinose. R. .... 6. **Ch. brunneola** Müll.-Arg.
Apothecia black, not pruinose. Sp. 8–11 μ diam. R. .... 7. **Ch. melanophæa** Zwackh.

3. **CONIOCYBE** Ach.—Effuse, thin, mostly pulverulent, sometimes obsolete. Apothecia stalked, light-coloured, the capitulum more or less globose and powdery with the protruded spores; paraphyses slender; spores spherical, simple, colourless, yellowish or pale-brownish.

On dead trunks, on twigs or on mosses, rarely on rocks.

Thallus well developed, greenish. Fruit stalks long. C.	1. C. furfuracea Ach.
Thallus scanty, whitish. Fruit stalks short.	
Capitulum and sp. bright-yellow. R.	2. C. sulphurea Nyl.
Capitulum white or brownish, sp. up to 10 μ diam. R.	3. C. pallida Fr.
Capitulum white or pale-reddish, sp. up to 3 μ diam. R.	4. C. hyalinella Nyl.

4. **CALICIUM** Pers.—Granular, pulverulent or obsolete. Apothecia stalked or almost sessile, lens- or top-shaped, brown or black, often pruinose; spores oblong-ovoid, 1-septate, sometimes slightly constricted at the septum, smoky- or dark-brown, from 5 μ to 16 μ in length.

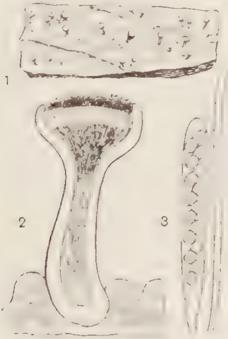


FIG. 12.—*Calicium quercinum* Pers. 1. Plant, nat. size. 2. Vertical section of thallus, stalk and capitulum × 25. 3. Ascus with spores and paraphysis × 500.

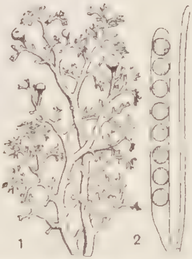


FIG. 13. — *Sphærophorus globosus* Wain. 1. Portion of plant, ½ nat. size. 2. Ascus with spores and paraphysis × 500.

On trunks of old trees or on dead wood (*C. arenarium* is parasitic). The pruina is mainly visible on the capitulum.

Capitulum yellow pruinose.	
Parasitic on *Lecidea lucida*, on stones. F.	1. C. arenarium Nyl.
Growing on oaks, thallus grey. R.	2. C. roscidum Floerke.
Capitulum reddish-pruinose.	
Thallus granular, bright-greenish-yellow. C.	3. C. hyperellum Ach.
Thallus thin, greyish-white or obsolete. C.	4. C. sphærocephalum Wahlenb. (*C. trachelinum* Ach.)

Capitulum whitish-pruinose. Thallus greyish.
  Stalks long. F.................................... 5. C. quercinum Pers.
  Stalks short, spores protruded. C.. 6. C. curtum Turn. & Borr.
Capitulum not pruinose.
  Thallus whitish or absent. Apothecia minute.
    On wood. Sp. fusiform or clavate. R. 7. C. pusillum Floerke.
    On wood. Sp. fusiform-ellipsoid. R. 8. C. debile Turn. & Borr. (*C. parietinum* Ach.)
    On bark of poplars. R.................... 9. C. populneum De Brond.
    On bark of holly. R. .... 10. C. diploellum Floerke.

5. **STENOCYBE** Nyl.—Thallus in spots (macular), thin, often obsolete or none proper. Apothecia stalked, scattered, black, minute, the capitulum top-shaped or clavate; spores ellipsoid or fusiform, large, becoming 3- (or more) septate, colourless, then brown.

On bark, or parasitic on other bark lichens.

On holly. Sp. up to 36 μ long. R......................... 1. S. major Nyl.
On holly and on other lichens. Sp. up to 70 μ long. F. 2. S. septata Rehm.
On alder bark. Sp. up to 23 μ long. R. .... 3. S. byssacea Nyl.

6. **CYPHELIUM** Ach. (*Trachylia* Fr.).—Granular or powdery. Apothecia sessile or almost immersed in the thallus, semi-globose, becoming open and plane, black, with a thin thalline margin; sporal mass plane, black; spores ellipsoid, rather large, mostly 1-septate, brownish-black.

On old palings, etc. One species is parasitic, and is found on the same habitat as the host lichen.

Spores 1-septate.
  Thallus yellowish or greenish. R.......... 1. C. tigillare Ach.
  Thallus grey or greyish-white. C.......... 2. C. inquinans Trev.
  Parasitic on *Pertusariæ*. R.................. 3. C. stigonellum A. Zahlbr.
Spores pluri-septate and muriform.
  Thallus bright greenish-yellow. R. 4. C. Notarisii A. Zahlbr.

FAMILY II. SPHÆROPHORACEÆ.

Thallus erect, leafy or shrubby, corticated or, in leafy forms (foreign), scarcely corticated below. Algal cells Protococcaceæ. Apothecia sessile on the tips of an upright thallus, or at the edge or underside of a leafy thallus, open from the beginning, or surrounded by a thalline covering. Spermatia oblong, on short-celled tissue-like sterigmata.

Only one genus of this family has been found, so far, in the British Isles.

The spores as in other genera of Coniocarpineæ form a powdery mazædium.
  Thallus shrubby... 7. Sphærophorus Pers.

7. **SPHÆROPHORUS** Pers. Thallus shrubby, composed of upright stalks irregularly branched, the cortical layer cartilaginous, smooth and shining, the central medullary layer white and rather soft. Apothecia terminal on the primary stalks or branches, innate in the swollen tips, globose or sub-

globose, at length bursting irregularly; paraphyses slender; spores 8, globose, simple, dark, in copious black masses.

Mostly found in regions of moorland and rocks, where they often grow in great profusion.

Main branches with short branchlets or fibrillæ.
Branches flattened. C............................ 1. S. melanocarpus Schær. (*S. compressus* Ach.)
Branches round. C............................... 2. S. globosus Wain. (*S. coralloides* Pers.)
Branches without fibrillæ. C........................ 3. S. fragilis Ach.

Subseries II. *CYCLOCARPINEÆ.*

Thallus crustaceous, squamulose, foliose or foruticose. Algal cells blue-green (Myxophyceæ), or bright-green (Chlorophyceæ). Fruits a roundish apothecium open or partially open from the first, marginate or immarginate, the margin composed of hyphæ alone (*proper*) or including gonidia (thalline). Asci and spores various.

The Cyclocarpineæ include a large and varied series of lichens that differ widely in the characters of thallus and fruit. The algæ are blue-green (Myxophyceæ) in a comparatively small number of families and genera; mostly they are bright green or yellow (Chlorophyceæ). In the former case the thallus is frequently gelatinous when moist, as are the algæ which are distributed equally through the thallus (*homoiomerous*), though also sometimes non-gelatinous, with the algæ arranged in a definite zone (*heteromerous*). The thallus containing Chlorophyceæ is non-gelatinous and nearly always heteromerous.

Thallus homoiomerous, gelatinous when moist, varying in form. Algæ Myxophyceæ.
With *Scytonema* or *Stigonema*, crustaceous or minutely fruticose.............. III. EPHEBACEÆ.
With *Glœocapsa*, crustaceous, minutely squamulose or fruticose.................. IV. PYRENOPSIDACEÆ.
With *Rivularia*, fruticose or squamulose, small.... . . .. V. LICHINACEÆ.
With *Nostoc*, crustaceous, squamulose or foliose.. . . . . VI. COLLEMACEÆ.
Thallus heteromerous, not gelatinous when moist. Algæ in a definite zone. Spores simple or 1-septate.
Algæ blue-green (bright-green in *Psoroma*). Apothecia small.
Crustaceous, squamulose or subfoliose, minute.... .. .. VII. PANNARIACEÆ.
Algæ blue-green or bright-green. Apothecia large.
Foliose. Spores septate.
Apothecia without a thalline margin, adnate.......................... .... VIII. PELTIGERACEÆ.
Apothecia with a thalline margin, scutellate .... IX. STICTACEÆ.

Algæ constantly Chlorophyceæ.
Apothecia large, with thalline margin.
Foliose. Spores simple .... X. Parmeliaceæ.
Fruticose. Spores simple or septate...... XI. Usneaceæ.
Apothecia small to moderate in size, with thalline margin.
Thallus various. Spores polarilocular... XII. Physciaceæ.
Apothecia mostly small, with thalline margin.
Crustaceous or minutely squamulose.
Apothecia single, with simple margin XIII. Lecanoraceæ.
Apothecia several in verrucæ............ XIV. Pertusariaceæ.
Apothecia with double margin.......... XV. Thelotremaceæ.
Byssoid, spongy (sterile in British Isles) XVa. Chrysothricaceæ.
Apothecia mostly small, without thalline margin.
Foliose, expanded. .... XVI. Gyrophoraceæ.
Squamulose, and with upright podetia ... XVII. Cladoniaceæ.
Filamentous.. XVIII. Cœnogoniaceæ.
Crustaceous or minutely squamulose...... XIX. Lecideaceæ.

Family III. EPHEBACEÆ.

Thallus more or less gelatinous when moist, minutely fruticose, crustaceous or partly squamulose, corticated or non-corticated. Algal cells Myxophyceæ (*Scytonema* or *Stigonema*). Apothecia rather small, discoid, mostly with a proper margin only; spores 8, colourless, simple or septate. Spermogones partly immersed in the thallus, with simple or septate sterigmata and minute ellipsoid acrogenous or pleurogenous spermatia.

The algæ in this family are species of *Scytonema* with uni-seriate cell-rows, or *Stigonema*, with the cell-rows in several series. The algal rows may be broken up into groups of cells.

Algal cells *Scytonema*.
Crustaceous. Spores simple.. 8. **Porocyphus.**
Minutely fruticose.
Fronds, without a cortex... 9. **Thermutis.**
Fronds, with a cellular cortex.
Apothecia moderate in size. Spores 1-septate ... 10. **Polychidium.**
Apothecia minute. Spores simple .... 11. **Leptogidium.**
Minutely squamulose-coralloid. Spores septate...... 12. **Placynthium.**
With upright fronds. Sterile.................................. 13. **Schizoma.**
Algal cells *Stigonema*.
Fronds minute. Apothecia black .... 14. **Spilonema.**
Fronds elongate. Apothecia pale.
Smooth. Paraphyses absent.............................. 15. **Ephebe.**
Spiny. Paraphyses present .... 16. **Ephebeia.**

8. **POROCYPHUS** Koerb. Crustaceous, continuous or areolate or granular, slightly gelatinous. Algal cells *Scytonema*. Apothecia small, immersed, closed then open, with a stout thalline margin; paraphyses slender, discrete; asci usually rather irregular in form, often bent or twisted; spores 8, ellipsoid, simple, colourless.

Thallus blackish, thin. Sp. 9–16 μ × 8–10 μ. Rocks. R. P. areolata Koerb.

9. THERMUTIS Fr. (*Gonionema* Nyl.). Minutely shrubby or felted, of thread-like, sparingly branched fronds. Algal cells *Scytonema*, a single cell-row in each filament, the lichen hyphæ growing parallel within the gelatinous sheath of the alga. Apothecia small, flattened-globose, lateral on the fronds; paraphyses unbranched, slender; asci elongate; spores 8, colourless, ellipsoid or elongate, simple.

The species are all rather rare; they grow on moist rocks in upland districts. The brown filaments differ very slightly in appearance from those of *Scytonema*.

Filaments spreading. S. .... 1. Th. velutina Th. Fr.
Filaments compact. S. .... 2. Th. compacta A. L. Sm.

10. POLYCHIDIUM S. F. Gray.—Thallus minute, foliose, with narrow laciniæ or shrubby and branched, the branches terete, with a well-developed cellular cortex. Algal cells, *Scytonema*, in parallel longitudinal lines. Apothecia moderate in size, sessile, lateral or terminal, brown; spores 8, elongate-fusiform, 1-septate, colourless.

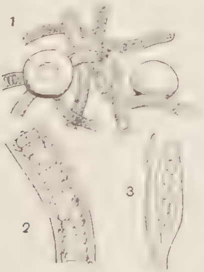


FIG. 14.—*Thermutis velutina* Th. Fr. 1. Portion of plant × 50. 2. Filament × 150. 3. Ascus with spores and paraphysis × 350.

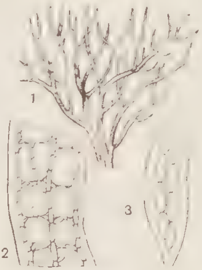


FIG. 15.—*Ephebe lanata* Wainio. 1. Portion of plant × 5. 2. Portion of filament × 100. 3. Ascus × ca. 700.

The single British species is not uncommon in moorland and upland districts, among mosses on rocks and walls.

Dark-brown or olive-blackish, in cushion-like tufts .... P. muscicolum S. F. Gray.

11. LEPTOGIDIUM Nyl. Thallus minutely shrubby and tangled, the fronds terete, with a well-developed cellular cortex and a central medullary strand of hyphæ. Algal cells, *Scytonema*, in parallel longitudinal lines. Apothecia small, reddish or brownish; spores 8, colourless, ellipsoid, simple.

A tropical genus of which one species occurs in S.W. Ireland. The specimens are sterile; imperfectly developed spermogones are present.

Finely filamentous, olive-greenish, on mossy trunks .... L. dendriscum Nyl.

12. PLACYNTHIUM S. F. Gray. Granular, crustaceous and cracked-areolate, or minutely coralloid-squamulose, almost entirely homoiomerous with a plectenchymatous cortex and usually with a well-developed hypothallus of stout blackish-blue hyphæ. Algal cells *Scytonema*. Apothecia sessile, plane or convex, with a proper margin only; paraphyses stoutish, unbranched, septate, thicker and dark-coloured at the tips; spores 8, elongate or ellipsoid-ovate, 1–7-septate, colourless.

Placynthium nigrum (*Pannularia nigra* Stiz.) is fairly common on calcareous rocks.

Minute coralloid, dark-coloured sq.
Spores 1-, sometimes 3-septate. C. .. .. 1. P. nigrum S. F. Gray.
Sp. more distinctly septate: f. *psotina*; crustaceous and sp. 3-septate: f. *triseptata*.
Alpine rocks.
Thin, crustaceous, brown. Mosses.
Alpine. R. .... 2. P. delicatulum A. L. Sm.

13. **SCHIZOMA** Nyl. Laciniate-linear, gelatinous when moist, non-corticate. Algal cells *Scytonema*. Apothecia unknown. Spermogones with minute cylindrical spermatia slightly wider at the ends, acrogenous, on sparingly branched sterigmata.

Fronds angular, cylindrical, stoutish up to 1 cm.
long. Mosses. Alpine. R................................ *S. lichenodeum* Nyl.

14. **SPILONEMA** Born. Minutely shrubby, with branching fronds. Algal cells *Stigonema*, in rows of several series of cells. Apothecia small, lenticular; paraphyses mostly thickish, septate; spores 8, simple or 1-septate, colourless.

Distinguished from the two following genera by the minute thallus and the almost black flat apothecia. The species grow in minutely felted dark-brown patches on moist rocks in subalpine districts.

In rather loose felted patches. Sp. simple. R...... 1. S. paradoxum Born.
In small agglutinate pulvinuli.
Sp. oblong, simple. R. .... 2. S. revertens Nyl.
Sp. ovoid-oblong, 1-septate. S...................... 3. S. scoticum Nyl.

15. **EPHEBE** Fr. Fruticose, slender, in spreading tufts, branched and intricate, without a cellular cortex. Algal cells *Stigonema*, the lichen hyphæ external to the alga in young stages, forming central strands in the older branches. Apothecia minute, solitary or aggregate, immersed in swollen portions of the fronds; paraphyses none; spores simple or 1–3-septate.

The single species forms matted irregular tufts on moist shady rocks, especially by streams. It is fairly abundant in hilly and mountainous regions.

Dark-olive-green or brownish-black, in fairly large patches. E. lanata Wainio (*E. pubescens* Nyl.)

16. **EPHEBEIA** Nyl. Thallus similar to that of *Ephebe*. Apothecia solitary, lateral, minute; paraphyses numerous, slender, slightly clavate at the tips; spores constantly simple, colourless.

The one recorded species is rather rare on damp rocks in subalpine districts.

Dark-olive-green or brownish-black, the filaments with
stiff spiny or hispid branchlets .... E. hispidula Nyl.

Family IV. PYRENOPSIDACEÆ.

Thallus gelatinous when moist, crustaceous, partly squamulose, or minutely fruticose, mostly non-corticated. Algal cells Myxophyceæ (*Glœocapsa*, *Chroococcus*, etc.). Apothecia small, open, or subimmersed and partly closed; spores 8, colourless, simple or rarely septate. Spermogones with ovate or elongate acrogenous spermatia.

The algal cells occur in small colonies, each surrounded by mucilage. They are blue-green, or are coloured red, especially towards the surface of the thallus, by the colouring substance Glœocapsin.

- Algæ with reddish sheath.
  - Crustaceous.
    - Apothecia open or plane................................ 17. **Euopsis.**
    - Apothecia almost closed................................ 18. **Pyrenopsis.**
  - Fruticose, of short tufts.. 19. **Synalissa.**
- Algæ with yellow sheath.
  - Crustaceous, dark-coloured.................................. 20. **Psorotichia.**

17. **EUOPSIS** Nyl.—Crustaceous, granular-areolate, fragile. Apothecia small or moderate in size, discoid, with a thalline margin; paraphyses septate; spores ellipsoid, simple, colourless.

Distinguished by the reddish colour of the crustaceous thallus, more pronounced when moist. The rather rare species grow on rocks in the mountainous regions of Wales, Scotland and Ireland.

- Effuse, thickish, coarsely areolate.......... 1. E. pulvinata Wainio. (*E. hæmalea* Nyl.)
- Effuse, areolate, the granules rounded .... 2. E. granatina Nyl.

18. **PYRENOPSIS** Nyl.—Crustaceous, granular, rarely subsquamulose or subfruticulose. Apothecia innate and partly closed, small or minute; paraphyses non-septate, slender; spores simple, rarely numerous.

Constantly darker than the preceding genus, though red in a thin section and differing in the almost closed apothecia and the non-septate paraphyses. More or less rare on maritime or mountainous rocks.

- Persistently dark-coloured.
  - Granular, thickish.
    - Granules in rounded groups. Alpine...... 1. P. hæmatopis Th. Fr
    - Granules effuse, deeply cracked-areolate. Alpine .... 2. P. homœopsis Nyl.
  - Granular, thinnish.
    - Granules in small aggregations or scattered. Maritime.............................. 3. P. fuscatula Nyl.
    - Granules effuse, in cracked-areolæ. Hilly or maritime.................................. 4. P. subareolata Nyl.
    - Granules in flattened squamules. Alpine 5. P. phylliscella Nyl.
- Reddish when moist.
  - Granules effuse, cracked-areolate. Alpine 6. P. furfurea Nyl.

19. **SYNALISSA** Fr. Minutely fruticose, or partly crustaceous, dark-coloured. Apothecia terminal, partly immersed, at first closed then open, with a thalline margin; spores ellipsoid, small, simple, colourless.

The thallus is tinged red- or dark-brown on the surface by Gloeocapsin. *S. intricata* from S. Scotland is of doubtful determination.

On calcareous rocks. S. .... 1. S. ramulosa Fr. (*S. symphorea* Nyl.)

On granite rocks. R. .... 2. S. intricata Nyl.

20. **PSOROTICHIA** Massal. Crustaceous, granular-areolate, more or less corticated, loosely affixed to the substratum. Algal cells *Gloeocapsa*, sect. *Xanthocapsa*. Apothecia innate, urceolate, small, the margin usually tumid and connivent; paraphyses slender; spores 8, ellipsoid, simple, colourless.

Closely allied to *Pyrenopsis*, but differing in the yellow colour of the algal sheath. It also somewhat resembles *Forssellia*, but is distinguished from that genus by the absence of a hypothallus. The species are very rare with the exception of *Ps. Schærcri* and *Ps. lugubris*.

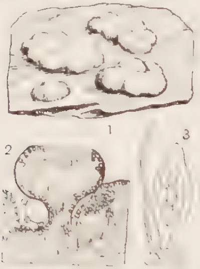


FIG. 16.—*Pyrenopsis phyllischella* Nyl. 1. Plant × 5. 2. Section of thallus and apothecium × 50. 3. Ascus and spores with paraphysis × ca. 350.

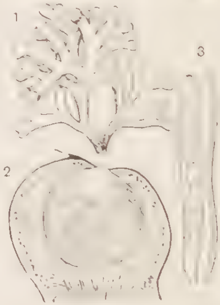


FIG. 17.—*Lichina pygmæ* Ag. 1. Portion of plant × 5. 2. Section of apothecium × ca. 30. 3. Ascus and spores with paraphysis × 175.

Spores ellipsoid.
  On calcareous rocks, cretaceous pebbles, etc.
    Thickish granular-areolate .... 1. Ps. Schæreri Arn.
  On sandstone or schistose rocks.
    Of scattered granules. Apo. black ...... 2. Ps. furfurella Boist.
    Of granular squamules. Apo. reddish... 3. Ps. diffundens Syd.
Spores spherical.
    Thickish, squamulose granular .... 4. Ps. lugubris Dalla Torre & Sarnth. (*Lecidea lugubris* Somm.)

Family V. LICHINACEÆ.

Thallus gelatinous when moist, crustaceous, sometimes lobed at the circumference, squamulose or minutely fruticose. Algal cells Myxophyceæ (*Rivularia*). Apothecia immersed and partly closed or open and with or without a thalline margin; paraphyses simple; spores 8, colourless, globose or ellipsoid, simple or septate. Spermogones with minute ellipsoid, acrogenous or pleurogenous spermatia.

Minutely shrubby. Maritime.. 21. **Lichina.**
Crustaceous or minutely squamulose.............................. 22. **Pterygium.**

21. **LICHINA** Ag.—Minutely fruticose, crowdedly branched, indistinctly corticated, dark-coloured. Apothecia terminal, immersed in the globose swollen tips, almost closed; paraphyses slender, sparingly branched; asci almost cylindrical; spores ellipsoid, simple.

A small maritime genus long regarded as brown algæ. Frequent on rocks washed by the tide or by the spray from the sea.

Short flattened lobes. Below high water.................. 1. L. pygmæa Ag.
Smaller rounded branchlets. At or above high water.... 2. L. confinis Ag.

22. **PTERYGIUM** Nyl.—Crustaceous, dark, granular or granular-areolate or minutely squamulose and usually somewhat lobed at the circumference. Apothecia sessile, without a thalline margin, the proper margin cellular; paraphyses septate, unbranched; spores ellipsoid or ovate, 1–3-septate.

On calcareous rocks.
Radiate-lobed. R. .... 1. Pt. filiforme A. L. Sm.
Not distinctly radiate. R. .... 2. Pt. lismorense Cromb.
On schistose rocks.
Crowded laciniæ. Alpine. R................. 3. Pt. pannariellum Nyl.
Nodulose squamules or granules. Lake shore. R.. 4. Pt. kenmorense A. L. Sm.

FAMILY VI. COLLEMACEÆ.

Thallus gelatinous when moist, crustaceous, fruticose or foliaceous, usually homoiomerous, corticated or not corticated, sometimes with rhizinæ. Algal cells Myxophyceæ (*Nostoc*). Apothecia partly closed or open, with reddish disc, immersed or sessile, the thalline margin present or wanting; spores usually 8, varying in form, simple, septate or muriform, colourless. Spermogones with pleurogenous or acrogenous spermatia.

In this family are found the most highly developed of the gelatinous lichens. The *Nostoc* chains retain as a rule their original form, and are scattered fairly equally through the thallus, except in some species of *Leptogium* which have more of a heteromerous character. Nearly all the species are some shade of dark-olive- or bluish green, sometimes almost black when dry.

Non-corticated.
Spores simple .... 23. **Physma.**
Spores septate-muriform .... 24. **Collema.**
Spores elongate, pluri-septate .... 25. **Synechoblastus.**
More or less corticated.
Spores simple .... 26. **Lemmopsis.**
Spores septate-muriform .... 27. **Leptogium.**

23. **PHYSMA** Massal.—Crustaceous, warted, squamulose or variously lobed or minutely fruticose, non-corticated, with or without rhizinæ. Apothecia innate, with a thalline margin which is sometimes cellular;

paraphyses slender, simple; asci clavate, often bent or twisted; spores fusiform, ellipsoid or globose, simple, colourless.

Rather rare among mosses on old walls or on the ground.

On old walls.	
Spores almost globose 11-12 μ × 9-10 μ	1. Ph. polyanthes Arn.
Spores ellipsoid 12-17 μ × 5-15 μ .	3. Ph. chalazanodes A. L. Sm.
On the ground.	
Apothecia minute; sp. 20-24 μ × 8-13 μ	2. Ph. chalazanum Arn.
Apothecia larger; sp. 17-23 μ × 8-10 μ..	4. Ph. confertum A. L. Sm.

24. **COLLEMA** Wigg. (emend. A. Zahlbr.). Variously lobed or almost crustaceous, gelatinous and swollen when moist, without rhizinæ, non-corticated. Apothecia with a thalline margin which is sometimes of plectenchyma; paraphyses conglutinate; spores fusiform or ellipsoid, variously septate and muriform, rather large.

On old walls, on the ground or on rocks, often among mosses, very rarely on trees. (See also *Leptogium* (*Collemodium*)).

*Apothecial margin entire (slightly crenate in n. 3).	
Indistinctly crustaceous.	
On bark. R.	1. C. terrulentum Nyl.
On moist clay. R.	3. C. glaucescens Hoffm.
Thallus lobate, lobes erect, crowded.	
Small, coralloid. Among mosses, alpine. R.	4. C. ceraniscum Nyl.
Lobes somewhat spreading, smooth.	
Pulpy, often plicate. Cal. and on ground. C.	5. C. pulposum Ach.
More flattened, small. Rocks and wall-tops. R.	6. C. concinnum Flot.
Thinner, imbricate, roundish or sub-palmate. Among mosses. F............	7. C. tenax Sm.
Apo. margin subentire. On walls and ground. F.	Var. coronatum Koerb.
**Apothecial margin granular (entire in *C. granosum* and *C. furvum*).	
Lobes not granular.	
Minute and imbricate, or large at edge; rhizinose below apo. Cal. C............	8. C. cheileum Ach.
Imbricate, margins erect, crisp or lacerate. Cal. C.	9. C. multifidum Schær. (*C. melænum* Ach.)
Short upright. Cal. R.	10. C. hypergenum Nyl.
Intricate, erect, deeply crenate. Among mosses. F.	11. C. cristatum Hoffm.
Lobes granular. Apothecial margin granular.	
Granules on surface. Cal. C..................	12. C. granuliferum Nyl.
Granules on surface and margins. Among mosses. F.	13. C. crispum Ach.
Lobes granular, large. Apothecial margin entire.	
Laciniate, granular on upper surface. Cal. R.	14. C. granosum Schær.
Entire, shell-like. F.	Var. auriculatum A. L. Sm.
Rounded, granular on both surfaces. Cal. F.	15. C. furvum Ach.

25. **SYNECHOBLASTUS** Trev.—Thallus variously lobed, gelatinous when moist, without rhizinæ, more or less appressed to the substratum, non-corticated. Apothecia with a thalline margin; spores 8, elongate-fusiform or acicular, pluriseptate.

Differs from *Collema* in the structure of the spores.

Lobes smooth, narrow. Cal. or on trees.	
Narrow. Apo. numerous, small, button-like. F.	1. S. polycarpus Dalla Torre & Sarnth.
Broader. Apo. numerous, small. R.	2. S. Laureri Flot.
Narrow, convex. Apo. few, mod. F.	3. S. multipartitus Mudd.
Upright, tufted. On trees. R.	4. S. fascicularis A. L. Sm.
Lobes rather broad, often granular. Mostly on trees.	
Radiately wrinkled. C.	5. S. nigrescens Anzi.
Smaller with irregular short wrinkles. F.	6. S. aggregatus Th. Fr.
Large, flaccid when moist, smooth. C.	7. S. rupestris A. L. Sm. (*Collema flaccidum* Ach.)

26. **LEMMOPSIS** A. Zahlbr.—Effuse, granular-crustaceous or nodulose, corticated. Apothecia sessile, with a proper margin, spores 8, ellipsoid, simple.

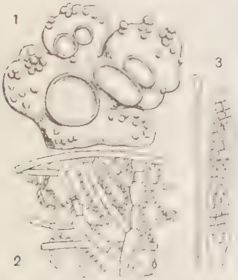


FIG. 18.—*Collema granuliferum* Nyl. 1. Part of plant. 2. Section of thallus × 225. 3. Ascus with spores and paraphysis × 150.

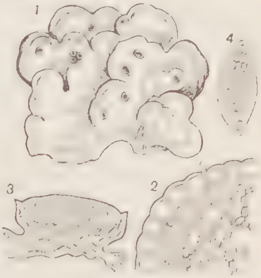


FIG. 19.—*Leptogium sinuatum* var. *scotinum* Koerb. 1. Part of plant. 2. Section of thallus × 225. 3. Vertical section of apothecium × 15. 4. Spore × 350.

Differs from *Leptogium* in the crustaceous thallus and simple spores. The species are rare, but may have been overlooked.

Forming a dark thin crust. Cal.	1. L. Arnoldiana A. Zahlbr.
Thallus lighter in colour. Cal. soil	2. L. oblongans A. L. Sm.
Thallus nodulose. Sil.	3. L. leptogiella A. L. Sm.

27. **LEPTOGIUM** S. F. Gray.—More or less gelatinous when moist, lobate, the lobes minute (subcrustaceous) or larger and spreading, corticate. Apothecia with a cellular thalline margin; paraphyses conglutinate; spores fusiform or ellipsoid, septate and muriform, colourless.

Differs from *Collema* in the corticate thallus, a very distinct character in some species, in others difficult to distinguish, especially in some of those included by Nylander in the genus *Collemodium*. As a rule the thallus is less swollen than in *Collema*, the lobes being often very thin. In some species the algæ tend to congregate towards the upper surface.

*Cortical cells somewhat indistinct (*Collemodium*).	
Thallus of small lobes.	
On trees. (Rarely on trees *L. plicatile*).	
Minute, nodulose, crowded. Apo. superficial. C.	1. L. fragrans Cromb. (*L. microphyllum* Leight.).
On soil.	
Agglutinate, papillate. Apo. immersed. F.	2. L. biatorinum Leight.
On rocks mostly calcareous.	
Small, turgid plicate, isidiose. Mostly on mortar. C.	3. L. turgidum Cromb.
Small, laciniate or nodulose, crenate, crowded. R.	4. L. fragile Nyl.
Thallus of larger lobes.	
Thick, plicate, wrinkled. Cal. F.	5. L. plicatile Nyl.
Thin, irregular, dark-green. On moist rocks. F.	6. L. fluviatile Cromb.
**Cortical cells well marked (*Euleptogium*).	
†Lobes granule-like. On rocks or mortar.	
Lacerate at circumference, isidiose. Alpine. R.	7. L. glebulentum Nyl.
Granules in areolæ. Alpine. R.	8. L. rhyparodes Nyl.
Granules turgid. Mortar. R.	9. L. humosum Nyl.
††Lobes small.	
On soil, mortar, etc.	
Minute, erect, crowded. Apo. superficial. R.	10. L. pusillum Nyl.
Minute, in pulvinate masses. Apo. embedded. F.	11. L. tenuissimum Koerb.
Granular laciniate. Apo. minute. F. or C.	12. L. subtile Nyl.
Thin, agglutinate. Apo. rather larger. R.	13. L. amphineum Nyl.
Thin, imbricate, crenate. Apo. minute. R.	14. L. minutissimum.
On rocks, mainly calcareous.	
Rosulate, scattered or crowded. Chalk nodules. R.	15. L. cretaceum Nyl.
Granular or elongate-lobate. R.	16. L. diffractum Kremp.
On slaty rocks, mortar or trees.	
Erect, nodulose, crowded. C.	17. L. microscopicum Nyl.
†††Thallus of med. erect lobes, usually dark-brown.	
Lobes almost cylindrical. In tufts on soil. C.	18. L. Schraderi Nyl.
Crowded, sinuate, crenate. Mossy rocks. C.	19. L. sinuatum Massal.
Lobes entire	Var. scotinum Leight.

Thin, lacerate, denticulate. Among mosses. C.	20. L. lacerum S. F. Gray.
In pulvinate masses	Var. pulvinatum Koerb.
††††Thallus of large lobes, dark or bluish-leaden.	
Smooth beneath.	
Narrow, erect, margin revolute. Mossy soil. F.	21. L. palmatum Mont.
Broad, entire, often crisp. Mossy rocks. C.	22. L. tremelloides S. F. Gray.
Longitudinally wrinkled. Mossy trees and rocks. R.	23. L. ruginosum Nyl.
Tomentose beneath. Mostly on trees.	
Submonophyllous, entire, dark-brown. S.	24. L. saturninum Nyl.
Thin, crenulate. Apo. margin leafy. F.	25. L. Burgessii Mont.

FAMILY VII. PANNARIACEÆ.

Thallus not gelatinous, heteromerous, granular, squamulose or foliose, with hypothallus or with rhizinæ. Algal cells blue-green, rarely bright-green. Apothecia with or without a thalline margin; hypothecium colourless or pale; paraphyses simple; spores 8, simple or septate, colourless or slightly brownish. Spermogones with upright, septate sterigmata and cylindrical pleurogenous spermatia.

Though containing blue green algæ, the Pannariaceæ differ from the previous families in the non-gelatinous heteromerous character of the thallus (*Pannularia nigra* is classified under *Placynthium*).

Algal cells *Nostoc*.	
Apo. without a thalline margin; sp. usually simple...	28. **Parmeliella.**
Apo. with a thalline margin; sp. usually simple......	29. **Pannaria.**
Algal cells *Scytonema*.	
Apo. without a thalline margin; sp. 1-septate	30. **Massalongia.**
Algal cells bright-green (Protococcaceæ).	
Apo. with a thalline margin; sp. simple	31. **Psoroma.**

28. **PARMELIELLA** Müll.-Arg. (*Pannularia* and *Coccocarpia* in part).—Squamulose or almost foliose, corticate, with a hypothallus or with rhizinæ. Algal cells *Nostoc*. Apothecia sessile, rather small; without a thalline margin; spores elongate or ellipsoid, simple (rarely 1-septate), colourless.

Mostly of minute greenish or leaden brown squamules. *P. plumbea* has a more massive, almost monophyllous thallus, with radiate-centric shell-like markings.

Thallus of small squamules.	
Plane, then granular, on black hypothallus. Trees. C.	1. P. corallinoides A. Zahlbr. (*Pannaria triptophylla* Nyl.).
Imbricate, margins whitish, black beneath. Rocks or soil. R.	2. P. microphylla Müll.-Arg.
Crenate, white beneath. Mosses on ground. R...................................	3. P. lepidiota Dal. Tor. & S.

Thallus foliose large, appressed.
  Almost monophyllous, grey-brown. Trees, 4. P. plumbea Wain.
    rocks. C. (*Coccocarpia plumbea* Nyl.).

29. **PANNARIA** Del.—Granular, squamulose or almost foliose, with a dark hypothallus of felted hyphæ, the upper cortex a plectenchyma of vertical cell rows. Algal cells *Nostoc*. Apothecia becoming superficial, with a thalline margin; spores elongate-ellipsoid or almost fusiform, simple, colourless.

Mostly squamulose, brown, bluish- or leaden-grey, dark-green when moist. Margins of apothecia granular or pulverulent.

Squamulose. Apothecia mostly red-brown.
  Sq. and apo. with silvery-white margins.
    Trees. C.. 1. P. rubiginosa Del.
      Becoming blue-grey sorediose. C............ Var. conoplea Koerb.
  Tawny-brown, imbricate. Mosses on ground. C. 2. P. pezizoides Leight.
    (*P. brunnea* Mass.).
  Leaden-grey, imbricate. Apo. blackish. Rocks. C. 3. P. Hookeri Nyl.
Granular, cracked.
  Grey, or dark-bluish-grey. Sandy soil. C....... 4. P. nebulosa Nyl.

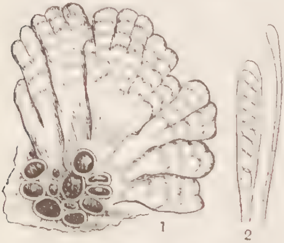


FIG. 20.—*Parmeliella plumbea* Wain. 1. Part of plant. 2. Ascus with spores, and paraphysis × 250.

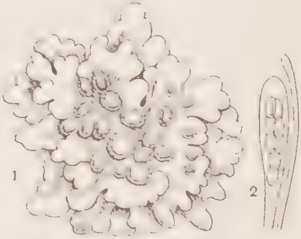


FIG. 21.—*Pannaria rubiginosa* Del. 1. Plant. 2. Ascus with spores, and paraphysis × 250.

30. **MASSALONGIA** Koerb. Thallus of medium-sized squamules, the cortex of the upper surface plectenchymatous, the lower surface decorticate and with dark rhizinose hypothallus. Algal cells *Scytonema*. Apothecia plane, without a thalline margin; spores colourless or becoming brownish, 1-septate.

Apo. small, red-brown, with paler margins. Mosses
  on rocks. F... 1.. M. carnosa Koerb.

31. **PSOROMA** Ach. Minutely squamulose-granular, upper surface corticate, the lower of closely packed parallel hyphæ which pass out as rhizoidal filaments. Algal cells bright-green (Protococcaceæ). Apothecia with a thalline margin; spores colourless, ellipsoid or globose, simple (rarely 2-celled).

The only British species strongly resembles *Pannaria pezizoides*.

Crenate-granular, tawny-brown. Mosses on
  ground. C. .... P. hypnorum S. F. Gray.

FAMILY VIII. PELTIGERACEÆ.

Thallus foliaceous or squamulose, heteromerous, corticate above, corticate or non-corticate below, and provided with a tomentum of hyphæ or with rhizoids. Algal-cells blue-green (*Nostoc*) or bright-green (*Dactylococcus*). Apothecia mostly marginal, roundish, adnate on the upper or lower surface, without a thalline margin; or scattered and sunk in the thallus; spores septate, colourless or brown. Cephalodia present in some of the genera.

Apothecia marginal.	
On upper surface	32. **Peltigera.**
On lower surface	33. **Nephromium.**
Apothecia scattered..	34. **Solorina.**

32. **PELTIGERA** Willd. Often wide-spreading, submonophyllous or polyphyllous, corticate on the upper surface; below, tomentose or veined, and more or less rhizinose. Algal cells blue-green or bright-green. Apothecia marginal, adnate on the upper surface of the frond; spores elongate fusiform, 3- or pluri-septate, colourless or brownish. Pycnidia sometimes present with ovoid acrogenous macrospores.

In most of the species the algæ are blue-green; in a few the gonidial zone is bright-green; but, in the latter, groups of *Nostoc* cells are always present in cephalodia, either superficial or within the tissue. The veining of the under surface is due to intercalary growth of the upper cortical layers which causes a stretching of the loose tissue below.

With blue-green gonidia	§ i. EUPELTIGERA.
With bright-green gonidia, and with cephalodia	§ ii. PELTIDEA.

§ i. EUPELTIGERA Wain.	
*Lobes downy above.	
Veins of under surface white.	
Large, spreading, with long white rhizinæ. C.	1. P. canina Willd.
Small, ascending, with few white rhizinæ. C.	2. P. spuria DC.
Veins of under surface dark-brown.	
Spreading, often crisp at margins. C.	3. P. rufescens Hoffm.
With leafy, isidiose margins	Var. prætexta Nyl.
**Lobes pulverulent, granular or scabrid above.	
Slightly pulverulent; brown below, almost without veins. R............	4. P. malacea Fr.
Granular, margins sorediate; brownish or white below. C.	5. P. scutata Koerb.
Scabrid; whitish below, black at centre. R.	6. P. scabrosa Th. Fr.
***Lobes naked, shining above.	
Apo. oblong, on digitate lobes, revolute. C................................	7. P. polydactyla Hoffm.
Apo. round, constantly horizontal. F.	8. P. horizontalis Hoffm.
§ ii. PELTIDEA Hue.	
Th. large. Cephalodia on surface as tubercles. F.	9. P. aphthosa Willd.
Th. small. Cephalodia on the veins. S.	10. P. venosa Hoffm.

33. **NEPHROMIUM** Nyl.—Lobate, horizontal, corticate on both surfaces, the under surface sometimes tomentose. Algal cells *Nostoc*. Apothecia marginal, roundish; adfixed on the lower surface of the thallus, finally directed upwards by the turning back of the fertile lobes, without a thalline margin; paraphyses simple, septate; spores fusiform, oblong, usually brownish, 1-3 septate. Spermogones with septate sterigmata and minute dumb-bell shaped pleurogenous spermatia.

Easily recognized when fertile by the position of the apothecia. If sterile it can be distinguished from *Peltigera* by the smaller more numerous lobes and by the habitat, the species growing mostly on the mossy trunks of trees, rarely on boulders. *N. lusitanicum* is the commonest.

Medulla K –.	
Tomentose beneath. R.	1. N. resupinatum Dalla Torre & Sarnth.
Wrinkled beneath. R.	2. N. lævigatum Nyl.
Lobes sorediate at margins. Less rare	Var. parile Nyl.
Medulla K + purplish.	
Med. yellow. C.	3. N. lusitanicum Nyl.
Med. white. R.	Var. hibernicum Nyl.

34. **SOLORINA** Ach.—Foliose, fragile, the upper surface corticate, the under surface partly nervose and rhizinose. Algal cells bright-green (*Dactylococcus*), along with blue-green (*Nostoc*). Apothecia superficial or urceolate and sunk in the upper surface of the thallus, irregularly scattered, suborbicular, reddish-brown, without a thalline margin; paraphyses thickish, septate; spores 2-8 in the ascus, fusiform-oblong or ellipsoid, 1-septate, brownish or reddish-brown. Spermogones unknown.

Nostoc cells occur in all of the species, as a layer under the gonidial zone in *S. crocea*, in squamules in *S. spongiosa*, or as endogenous scattered cephalodia in the other species. The apothecia are developed before the cortex covering them is thrown off, hence the term "veiled apothecia." The species grow on soil among rocks, etc., chiefly in upland mountainous districts.

Apothecia superficial.	
Th. large, saffron-yellow below. Ascus 8-spored. R.	1. S. crocea Ach.
Apothecia sunk in the thallus.	
Th. large. Sp. 4, warted. F.	2. S. saccata Ach.
Th. small. Sp. 4, smooth. R.	3. S. spongiosa Carroll.
Th. small; white-pruinose. Sp. 2. R.	4. S. bispora Nyl.

FAMILY IX. STICTACEÆ.

Thallus foliose, horizontal or somewhat ascending, corticate on both surfaces, beneath more or less tomentose. Cyphellæ or pseudo-cyphellæ constant on the under surface in *Sticta*. Cephalodia present in certain species. Algal cells blue-green (*Nostoc*) or bright-green (Chlorophyceæ). Apothecia marginal on the thallus or scattered, scutellate and sessile or shortly stalked; paraphyses simple, septate; spores elongate, 2-pluri-septate, colourless or brown. Spermogones with septate sterigmata and short straight pleurogenous spermatia.

Resembling Peltigeraceæ in that both types of gonidia, blue-green and bright-green are represented. The species with bright-green algæ frequently form cephalodia. Cyphellæ are small cup-like pits with a distinct rim that occur irregularly amongst the tomentum of the lower surface; pseudo-cyphellæ are less definitely margined, and are filled with loose hyphæ.

With cyphellæ or pseudo-cyphellæ on the under
surface .... 35. **Sticta.**
Without these structures .... 36. **Lobaria.**

35. **STICTA** Schreb.—Variously lobate or laciniate, horizontal, sometimes slightly ascending or stalked, cortex on both surfaces of plectenchyma; beneath pale- or dark-brown tomentose, with cyphellæ or pseudo-cyphellæ. Cephalodia rarely present. Algal cells *Nostoc* or Chlorophyceæ. Apothecia marginal or scattered, with or without a thalline margin; paraphyses simple, septate; spores 8, elongate, fusiform or acicular, 1–7-septate, colourless or brown (often sterile).

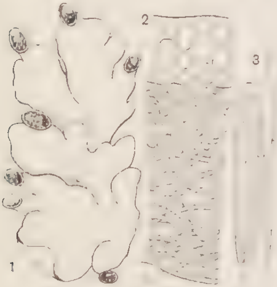


Fig. 22.—*Peltigera canina* Willd. 1. Part of plant reduced ½. 2. Section of thallus × 300. 3. Ascus with spores and paraphysis × 300.

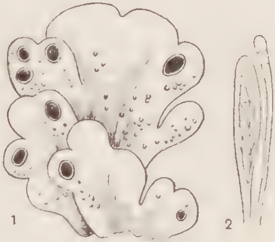


Fig. 23.—*Sticta fuliginosa* Ach. 1. Part of plant. 2. Ascus with spores and paraphysis × 250.

The genus is distinguished from other foliose lichens by the minute round openings cyphellæ or pseudo-cyphellæ in the tomentose under surface. The species grow among mosses on trees or rocks.

Algal cells *Nostoc* .... § i. Stictina.
Algal cells Chlorophyceæ .... § ii. Eusticta.

§ i. Stictina. Algal cells *Nostoc*. Rather wide-spreading.

Cyphellate.
Thallus isidiose. Lobes various.
Broadly rounded. C. .... 1. S. fuliginosa Ach.
Laciniate, deeply cut, rather pitted. C. .... 2. S. sylvatica Ach.
Thin, margins crisp, fimbriate. R. .... 3. S. Dufourii Del.
Thallus sorediate.
Lobes broad, margins sorediate. C. .... 4. S. limbata Ach.

Pseudo-cyphellate.
Sprinkled with white soredia. S. .... 5. S. intricata Del. var. Thouarsii Mudd.
Sprinkled with greenish-yellow soredia. S. ... 6. S. crocata Ach.

§ ii. EUSTICTA. Algal cells Chlorophyceæ.

Cyphellate.
Lobes sinuate, elongate, obtuse, med. white. R. .... 7. S. damæcornis Ach.
Pseudo-cyphellate.
Lobes rounded, med. bright-yellow. R. .... 8. S. aurata Ach.

36. **LOBARIA** Schreb.—Broadly foliose, horizontal or partly ascending, tomentose below, with the tomentum of single hyphæ or in strands. Algal cells blue-green (*Nostoc*) or bright-green (Protococcaceæ). Cephalodia sometimes present. Apothecia at first almost closed, then open and discoid, generally with a thalline margin; paraphyses simple, septate; spores 8, elongate, 1–9-septate, colourless or brown.

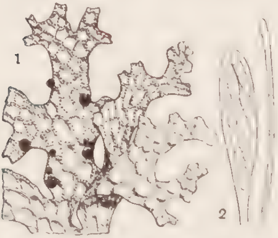


FIG. 24.—*Lobaria pulmonaria* Hoffm. 1. Part of plant reduced ½. 2. Ascus with spores and paraphysis × 250.

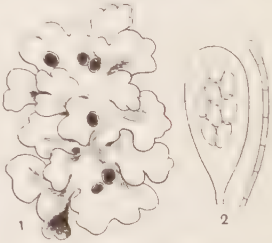


FIG. 25.—*Parmelia caperata* Ach. 1. Part of plant reduced ½. 2. Ascus with spores, and paraphysis × 500.

The British species are all very wide-spreading, green when moist and greyish-green or brown when dry. They grow mostly on the trunks of old trees, oak, etc., rarely on rocks. The genus is divided into two sections according to the algæ:—

§ i. LOBARINA. Algal symbiont *Nostoc*.

Lobes irregularly pitted, with scattered soredia. C. .... 1. L. scrobiculata DC.

§ ii. RICASOLIA. Algal symbiont Protococcaceæ.

Thick, wrinkled, with dark massed cephalodia. F. 2. L. laciniata Wain. (*Ricasolia amplissima* Leight.)
Thinner, shining, without cephalodia. F. 3. L. lætevirens A. Zahlbr.
Pitted, bullate below, sorediate. F. ... 4. L. pulmonaria Hoffm.

Family X. PARMELIACEÆ.

Thallus squamulose or foliose, horizontal, rarely ascending or subfruticose, corticate on one or both surfaces; beneath with rhizinæ or naked. Algal cells Protococcaceæ. Apothecia sessile or shortly stalked, with a thalline margin; spores 2–8 in the ascus (rarely more), colourless, simple. Spermogones with pleurogenous or more rarely acrogenous spermatia.

Thallus rhizinose. Apothecia superficial.
  Ascus polyspored .... 37. **Candelaria.**
  Ascus 2–8-spored .... 38. **Parmelia.**
Thallus scarcely rhizinose. Apothecia marginal ... 39. **Cetraria.**

37. **CANDELARIA** Massal.—Minutely foliose or sqamulose, corticate on both surfaces, yellow above; beneath almost colourless, rhizinose. Apothecia sessile, scattered, discoid, with a thalline margin; paraphyses discrete, simple or rarely branched, septate and clavate at the tips. Spores numerous, simple, colourless, sometimes bi-guttulate and pseudo-septate. Spermogones in small tubercles, with acrogenous ellipsoid spermatia.

The brilliant yellow colour is due to stictaurin, which gives no reaction with potash.

Squamules crenate; apothecium with granulate margin... C. concolor Wain.

38. **PARMELIA** Ach.—Lobate, laciniate or linear, variously coloured, generally somewhat shining; beneath more or less rhizinose or almost naked, and usually dark in colour, the rhizinæ of fasciculate hyphæ frequently mucilaginous at the tips. Soredia and isidia frequent. Apothecia scattered over the surface, sessile or shortly stalked, round, with a thalline margin; hypothecium colourless, with gonidia underneath; paraphyses usually branched and septate, conglutinate; spores 2–8, ellipsoid or subglobose, small or rather large, simple, colourless. Spermogones scattered, with septate sterigmata and minute pleurogenous spermatia.

Spores are small when 12 μ long or under; large above 20 μ long.

Normally without rhizinæ, lobes narrow .... Subgen. i. Hypogymnia.
Normally without rhizinæ, lobes broader, pierced
  with holes .... ,, ii. Menegazzia.
More or less rhizinose, lobes various.................. ,, iii. Euparmelia.

Subgen. i. Hypogymnia Nyl.—Thallus without rhizinæ on the free parts; lobes mostly narrow. Spores small.

Parmelia physodes grows mostly on trees, the other species on alpine rocks.

Glaucous-grey, spreading, tips sorediate. C. ... 1. P. physodes Ach.
  Lobes tubular, sorediate at tips .... Var. tubulosa Mudd.
  Wrinkled, almost coherent .... Var. platyphylla Ach.
Glaucous-grey, linear, black at edge, punctured
  below. R. .... 2. P. vittata Nyl.
Grey or dark, narrow, crowded, spathulate. R. 4. P. alpicola Th. Fr.

Subgen. ii. Menegazzia A. Zahlbr.—Thallus without rhizinæ, attached by haustoria; lobes narrow, perforate above. Spores large.

Thallus orbicular, dotted with holes, brownish.
  On rocks or trees. S. .... 5. P. pertusa Schær.

Subgen. iii. EUPARMELIA Nyl. Thallus lobes narrow or wide; beneath more or less rhizinose.

The largest number of species are included in this subgenus. There is great variation in the character of the lobes which may be almost filamentous (*P. pubescens*), divided up into narrow lobes (*P. omphalodes*), or broadly expanded (*P. cetrarioides*). Some species are almost destitute of rhizinæ and suggest *Cetraria*, but in that genus the apothecia are marginal on the lobes. The thallus varies in size from small (about 2–3 cm. across) to large (up to 20 cm. or more). The species grow on trees or pales, more rarely on rocks.

A. Rhizinæ very scanty.
Lobes almost black (on upland rocks; rather small).
Subterete, slender, branched, prostrate. F. 6. P. pubescens Wain. (*P. lanata* Wallr.)
Narrow, flattened, about 2 cm. high, semi-erect. P. 7. P. corniculata A. L. Sm. (*P. tristis* Wallr.)
Narrow, appressed, palmate, confusedly imbricate. R. .... 8. P. stygia Ach.

B. Rhizinæ abundant or scanty, but absent from the margin of the lobes (*Amphigymnia*).
Glaucous-grey.
Lobes broad, margins often sorediate, K+y. C. .... 9. P. perlata Ach.
Black, ciliate at the margins .... Var. ciliata Schær.
Yellowish-green.
Lobes wrinkled, rarely sorediate towards the centre, K+y. C. .... 10. P. caperata Ach.
Olivaceous or brown. Lobes various.
Appressed, with yellowish soredia, isidiose; med. K + y, C + red. Trees. F. ...... 11. P. subaurifera Nyl.
Appressed, linear with yellowish soredia, K + y. Rocks. F. .... 12. P. Mougeotii Schær.
Rounded, incurved, margins sorediate; med. C + red. Trees. R. .... 13. P. olivetorum Nyl.
Rounded, incurved, margins sorediate; med. C –. Trees. F. .... 14. P. cetrarioides Del.

C. Rhizinæ up to edge of lobes (*Hypotrachyna*). Lobes up to 1 cm. across.
*Grey or whitish.
†Lobes without isidia on soredia.
Thickish, smooth, rounded-crenate, K+y; med. C + red. C. .... 15. P. tiliacea Ach.
Black setæ on Apo. receptacle. R. ... Subsp. carporhizans Nyl.
††Lobes isidiose.
Rounded, centre with crowded dark isidia. C. .... 16. P. scortea Ach.
Crenate or dissected, isidia ciliate, K + y then red. F. .... 17. P. proboscidea Tayl.

Reticulate on surface. Med. K + y then red. C.	18. P. saxatilis Ach.
Thallus densely isidiose, f. *furfuracea;* lobes narrow and crowded, f. *panniformis*.	
†††Lobes sorediate over surface.	
Isidia becoming sorediate	17. P. proboscidea Tayl.
Soredia on reticulations	18. P. saxatilis Ach.
Reticulate; soredia in furrows, K + y; med. C + red. C.	19. P. sulcata Tayl.
Smooth or wrinkled, soredia punctiform, K + y; med. C + red. C.	20. P. dubia Tayl. (*P. Borreri* Turn.)
Small, appressed, soredia yellowish, K −. R.	21. P. ambigua Ach.
Small, appressed, soredia whitish, K + y. R.	22. P. hyperopta Ach.
††††Lobes sorediate on tips or margins.	
Finely reticulate, often ciliate, K + y, med. + y then red. F.	23. P. cetrata Ach. (*P. perforata* S. F. Gray.)
Branching with wide sinus, K + y. C.	24. P. lævigata Ach.
Branching with narrow sinus, subrevolute at tips; med. C + red. C.	25. P. revoluta Flœrke.
Rugose towards centre	Var. rugosa Cromb.
Medulla yellow. On rocks. R.	26. P. endochlora Leight.
**Yellowish-green.	
†Lobes without soredia, sometimes isidiose.	
Closely appressed, wrinkled, K + y then red. C.	27. P. conspersa Ach.
Crowded with isidia, f. *isidiata*.	
Crowded and imbricate	Var. stenophylla Ach.
††Lobes with soredia.	
Narrow, pinnatifid, tips broader, sorediate, K + y, med. + red. F.	28. P. sinuosa Ach.
Narrow, gnarled, soredia large, yellowish. Rocks. R.	29. P. multifida A. L. Sm. (*P. incurva* Fr.)
***Olivaceous, brown, or dark-green.	
†Lobes without soredia or isidia.	
Dull-green to brown, imbricate, K + y then red. F.	30. P. acetabulum Dub.
Bright- or dark-brown, appressed. R.	31. P. olivacea Ach.
Brown, appressed, with papillæ (breathing pores). F.	32. P. exasperata Carroll.
Dark, shining, reticulate, narrow (cf. n. 18), K + y, med. + red. C.	33. P. omphalodes Ach.
Blackish, shining, narrow, convex, K −. F.	34. P. prolixa Carroll.
Broader, appressed, not so dark. F.	Subsp. Delisei Nyl.
††Lobes isidiose.	
Sprinkled with isidia becoming sorediose, subsp. Delisei	Var. isidiascens Nyl.

Dark, shining, densely isidiose, med. C+ red. Rocks. C.	35. P. fuliginosa Nyl.
Lighter brown, less isidiose. Trees. C.	Var. lætevirens Nyl.
†††Lobes sorediate over surface.	
Blackish, narrow, appressed, K–. Rocks. R.	36. P. sorediata Th. Fr.

39. **CETRARIA** Ach. (incl. Platysma Nyl.).– Foliaceous (*Platysma*), partly horizontal or ascending, or fruticose (*Cetraria*) with the fronds compressed, rarely cylindrical, sparingly rhizinose, or attached at the base, but soon loose from the substratum, corticate on both surfaces, the cortex mostly of small-celled plectenchyma; the under surface shining, concolorous with the upper surface or darker; pseudo-cyphellæ present in some species. Apothecia marginal or submarginal, sessile or shortly stalked, round, with a thalline margin; paraphyses simple or rarely branched, septate; spores 6–8, colourless, simple, small. Spermogones in marginal tubercles or thorn-like papillæ, with pleurogenous spermatia varying in form.

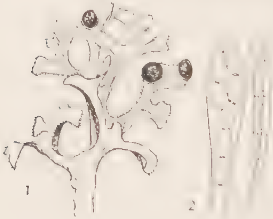


FIG. 26. — *Cetraria islandica* Ach. 1. Plant reduced ½. 2. Ascus with spores, and paraphysis × ca. 500.

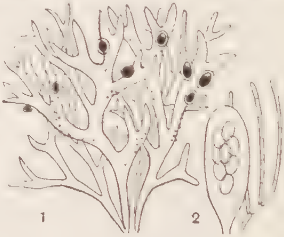


FIG. 27. — *Evernia prunastri* Ach. 1. Plant reduced ½. 2. Ascus with spores, and paraphysis × 500.

Differs from *Parmelia* in the almost complete absence of rhizinæ, in the partly ascending or fruticose habit, and in the marginal apothecia and spermogones. The species classified by some Lichenologists under *Platysma* are of a more foliaceous character, those in *Cetraria* are fruticose, but there are intermediate connecting forms.

*Thallus foliaceous, more or less horizontal (*Platysma*). On trees, rocks or soil.

†Lobes grey (rarely brown); plants large.	
Smooth, with raised crisp margins. C. ...	1. C. glauca Ach.
Whitish beneath	Var. fallax Ach.
With narrow crowded lobes...........	Var. tenuisectum A. L. Sm.
Reticulate-lacunose. R.	2. C. lacunosa Ach.
Appressed (small) densely isidiose. F. ...	3. C. diffusa A. L. Sm.
††Lobes bright-yellow; plants rather small.	
Bare at margins. R.	4. C. juniperina Ach.
Yellow-pulverulent at margins. R.	5. C. pinastri S. F. Gray.

†††Lobes brown; plants rather small.	
Small, sinuate and bare at margins. R.	6. C. sepincola Wain.
Larger, white pulverulent at margins. C.	7. C. chlorophylla Wain. (*Platysma ulophylla* Nyl.)
††††Lobes almost black, very narrow. On rocks.	
Grooved. Apo. with stout crenulate margin. R.	8. C. hepatizon Wain. (*P. fahlunense* Nyl.)
Plane. Apo. with thin subentire margin. R.	9. C. fahlunensis Schær. (*P. commixtum* Nyl.)
More ascending, light beneath. Apo. with stout crenulate margin. R.	10. C. polyschiza Lett.

**Thallus ascending, more or less fruticose (*Eucetraria*). Mostly among mosses on the ground. With the exception of *C. aculeata*, the species are all rather rare in this country.

†Fronds pale-yellowish.	
Smooth, connivent at margin. Rocks; alpine	11. C. cucullata Ach.
Reticulate-lacunose, connivent. In hilly regions	12. C. nivalis Ach.
††Fronds pale- to dark-brown; pseudocyphellæ present.	
Strap-shaped, rather wide, spinulose at margins..................................	13. C. islandica Ach.
Very broad, f. *platyna*.	
Narrower, canaliculate	Var. tenuifolia Wain.
Crowded, densely branched upwards. Alpine..................................	14. C. hiascens Th. Fr.
†††Fronds dark-chestnut-brown.	
Cylindrical or compressed, branched and entangled	14. C. aculeata Fr.
More slender, generally well fruited, f. *hispida*; stoutish, very spinose, f. *acanthella*.	
Densely cæspitose, palmately branched above. Rocks........................	16. C. odontella Ach.

Family XI. USNEACEÆ.

Fruticose, attached at the base, usually radiate in structure. Algal cells Protococcaceæ. Apothecia roundish, sessile or shortly stalked, with a thalline margin; spores 1–8, colourless or rarely brown, simple or septate. Spermogones immersed, with acrogenous or pleurogenous spermatia.

Distinguished by the fruticose thallus. Transition stages between the foliaceous and fruticose types occur in *Evernia*. *Cerania* is doubtfully included in the family.

Strap-shaped.	
Structure dorsiventral, with under surface of different colour	40. Evernia.
Structure radiate, alike on both surfaces	41. Ramalina.

Filamentous.	
Medulla a central chondroid strand..........................	42. **Usnea.**
Medulla of loose arachnoid hyphæ	43. **Alectoria.**
Stalk-like.	
Fronds hollow, tapering upwards	44. **Cerania.**

40. **EVERNIA** Ach.—Strap-shaped, erect or partly pendulous or decumbent, more or less divided or branched, rather soft and flaccid, differently coloured above and below, attached by a basal sheath, occasionally with a few rhizinæ. Structure subdorsiventral, the gonidia mostly under the upper cortex. Apothecia lateral, or almost terminal, sessile or shortly stalked; paraphyses stoutish, simple; spores 8, small, ellipsoid, simple. Spermogones lateral, immersed, with pleurogenous straight slender spermatia.

A genus intermediate between *Parmelia* and *Ramalina*, resembling the former in the almost constantly dorsiventral structure, and the latter in the fruticose habit. The fronds vary in height up to about 10 cm. or even longer. In *Evernia prunastri* var. *stictoceros* the *Ramalina*-like fronds have an *Evernia* structure. On trees, old palings, etc., *E. furfuracea* sometimes on rocks.

Light-greenish-grey, sorediate, white beneath. C.	1. E. prunastri Ach.
Yellowish-green on both surfaces	Var. stictoceros Hook.
Darker-grey, isidiose, black beneath. C.	2. E. furfuracea Mann.
Densely isidiose: f. *scobicina;* narrow, subcylindrical: f. *cerata.*	

41. **RAMALINA** Ach.—Fronds erect or partly pendulous, branched, compressed, strap-shaped or almost subcylindrical, attached by a basal sheath or by penetrating hyphæ; structure radiate, the medulla generally of loose hyphæ, the gelatinous cortex formed of thick-walled coalescing hyphæ growing generally at right angles to the long axis of the plant; a system of strengthening longitudinal hyphæ forming a ring or separate strands within the cortex (rarely absent). Soralia not infrequent. Air-pores occurring as breaks in the thallus. Apothecia terminal or lateral, sometimes on the angle of bent fronds (geniculate); paraphyses simple; spores 8, colourless, 1-septate, straight or curved.

The fronds vary from being almost narrowly cylindrical in some specimens of *R. calicaris* to a broad flat expansion in *R. evernioides*. The species are common unless otherwise indicated.

On trees. Without soredia.	
Long, stiff, generally narrow, often canaliculate, spores straight	1. R. calicaris Fr.
Rather broad and flat, spores curved............	2. R. fraxinea Ach.
Rather short, rigid, fastigiate; spores curved	3. R. fastigiata Ach.
Short, subpellucid, in cushion-like growths. R.	4. R. dilacerata Wain.
Short, subfastigially branched, fistulose, perforated. R.	5. R. geniculata Nyl.
On trees. Sorediate.	
Narrow, margins sorediate. K—	6. R. farinacea Ach.
Broad, farinose-sorediate, longitudinally wrinkled	7. R. pollinaria Ach.
Broad, surface or margins sorediate, transversely wrinkled-reticulate	8. R. evernioides Nyl.

On rocks. Without soredia.
    Narrow, rigid. Mostly maritime .... 9. R. siliquosa A. L. Sm. (*R. scopulorum* Ach. and *R. cuspidata* Nyl.)
    Narrow, rigid, almost round, black at base. Maritime.. 10. R. Curnowii Cromb.
On rocks. Sorediate.
    Narrow, sorediate on margins, K + y then red 11. R. subfarinacea Nyl.
    Short, margins and surface sorediate............ 12. R. polymorpha Ach.
    Short, tips sorediate.................................. 13. R. capitata Nyl.

42. **USNEA** Dill. Filamentous, upright or pendulous, more or less cylindrical, variously branched, often scabrid, greyish-green or yellowish, attached at the base by a sheath or by a penetrating holdfast; structure radiate, with a firm chondroid central axis or rarely hollow, the cortical layer thin, of branching swollen hyphæ. Apothecia mostly rather large, lateral or terminal, peltate, the disc mostly rather light-coloured, with a thalline, generally ciliate, margin; hypothecium colourless, with underlying gonidia; paraphyses concrete, branched and septate; spores 8, small, ellipsoid, simple. Spermogones lateral, immersed or slightly protuberant, light or dark coloured with sparingly branched sterigmata and acrogenous spermatia.

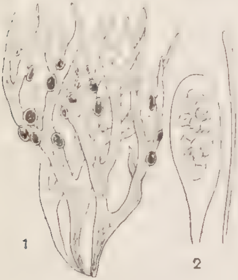


FIG. 28. — *Ramalina fraxinea* Ach. 1. Plant reduced ½. 2. Ascus with spores, and paraphysis × 500.

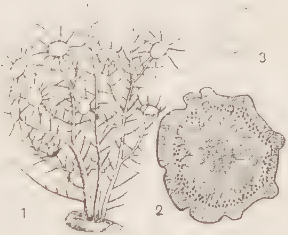


FIG. 29. — *Usnea florida* Web. 1. Plant reduced ½. 2. Transverse section of thallus × 35. 3. Spore × 750.

The species of *Usnea* occur chiefly on trees in forests, and the pendulous forms (British) may attain a length of 1 ft. or more; occasionally they grow on rocks. Nearly all are sorediate, and, in some species, the soredia develop on the parent plant into lateral branchlets. Flesh-coloured wrinkled tubercles are frequently formed and are irregularly scattered over the filaments. They contain no gonidia and are only abortive apothecia. Reddish forms are not uncommon.

Filaments erect, branched.
    Generally with horizontal fibrils (10-12 cm. high). C. .... 1. U. florida Web.
        Smaller, sorediate, non-fertile .... Var. hirta Ach.

Erect, branches few, cornute, sorediate. R. 2. U. cornuta Koerb.
Sparingly fibrillose, ringed, verrucose (becoming pendulous). C. 3. U. plicata Web. (*U. ceratina* Ach.)
Filaments pendulous.
Long, crowded, scabrous and fibrillose. C. 4. U. barbata Web. (*U. dasypoga* Stiz.)
Smooth and sparingly fibrillose .. .. Var. pendula Heb. Howe.
Long, crowded, nearly smooth, with swollen "articulations." F. .... 5. U. articulata Hoffm.

43. **ALECTORIA** Ach.—Filamentous, erect or mostly pendulous, often shining, branched, cylindrical or partly compressed, attached by a basal sheath; structure radiate, the medulla of loose hyphæ or partly hollow, the cortical layer formed of hyphæ parallel with the long axis of the plant (fibrous). Apothecia lateral or bent, on straight branches, the margin rarely ciliate, the disc brown or blackish; hypothecium colourless, with underlying gonidia; paraphyses branched; spores 4–8, ellipsoid, simple, colourless or brownish. Spermogones in small lateral tubercles, the sterigmata sparsely branched, with pleurogenous, short spermatia, slightly thickened at each end.

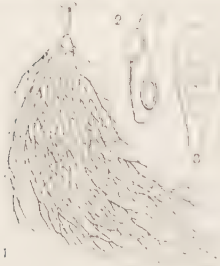


FIG. 30.—*Alectoria jubata* Ach. 1. Plant reduced ½. 2. Portion of filament with apothecia × ca. 8. 3. Ascus with spores, and paraphysis × 500.

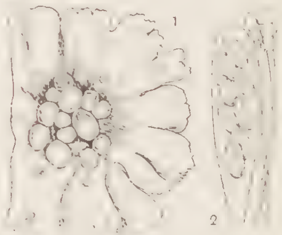


FIG. 31.—*Xanthoria parietina* Th. Fr. 1. Part of plant. 2. Ascus with spores, and paraphyses × 350.

The species of *Alectoria* are confined to upland or mountainous regions where they are frequently abundant. They grow on soil, rocks or trees and they vary from light straw-coloured to brownish-black. Occasionally the filaments become free from the substratum, growth still continuing at the tips. Rare except *A. bicolor* and *A. jubata.*

Filaments mostly yellowish straw-coloured.
Erect, rigid, with tufted blackish branchlets at tips. Mossy soil.................................... 1. A. ochroleuca Nyl.
Decumbent, entangled, with blackish areas ...... Subsp. cincinnata Th. Fr.
Pendulous or decumbent, branches few. Mossy soil.. 2. A. sarmentosa Ach.

Pendulous or decumbent, branched, sorediate at
tips. Trees or rocks.................................. 3. A. thrausta Ach.
Pendulous, long, slender, much branched. Firs 4. A. implexa Nyl.
Filaments mostly dark-coloured.
Erect, rigid, dull black, lighter at base. Rocks, etc. 5. A. nigricans Nyl.
Erect, short, densely branched, black with brownish areas. Firs.. 6. A. bicolor Nyl.
Decumbent, branches spreading, blackish-brown.
Mossy soil.. 7. A. divergens Nyl.
Pendulous, long, dull black, sorediate. Trees, etc. 8. A. jubata Ach.
Short greyish-coloured. Firs........................ Subsp. subcana Nyl.
Subdecumbent short, very dark. Rocks........ Subsp. chalybeiformis Th. Fr.

44. **CERANIA** S. F. Gray (*Thamnolia* Ach.). Fronds upright, hollow, stalk-like, sparingly branched, tapering upwards; the cortex of small cells, medulla of parallel hyphæ. Apothecia not rightly known. Spermogones immersed in small warts, with pleurogenous short cylindrical straight or slightly bent spermatia.

The position of the genus is uncertain in the absence of definite knowledge as to the reproduction of the plant. Though of upright structure it is frequently prostrate; the one known species is chalky-white, somewhat resembling white worms. On soil among mosses, etc., in mountainous regions.

Generally up to 5 cm. in length and 1 to 2
or 3 mm. thick.. C. vermicularis S. F. Gray.

FAMILY XII. PHYSCIACEÆ.

Thallus fruticose, foliose, squamulose or crustaceous, yellow-coloured, grey or brown. Structure various. Algal cells Protococcaceæ. Apothecia discoid, mostly rather small, usually with a thalline margin. Spores colourless or brown, usually 1-septate, with thick outer walls and septum, the latter generally pierced by a longitudinal canal (polarilocular), rarely simple or 3-septate. Spermogones with cellular sterigmata and short pleurogenous spermatia (except in *Candelariella*).

The genera in this family are especially distinguished by the peculiar spores. The median septum develops by ingrowth from the outer wall, and though occasionally a narrow band, it broadens sometimes to such an extent that the lumen of the cells is reduced to a small space at each pole. A few species with simple or even 3-septate spores are included in the genera owing to the presence of other typical characters.

Parietin present (yellow lichen-acid colouring crimson
or purple with potash).
Spores colourless, usually 1-septate, 8 in the ascus.
Fruticose, yellow.. 45. **Teloschistes.**
Foliose, yellow.. 46. **Xanthoria.**
Squamulose or crustaceous, mostly yellow...... 47. **Placodium.**
Parietin not present.
Spores colourless, simple at first, sometimes many
in the ascus.
Crustaceous, yellow..................................... 48. **Candelariella.**

Spores brown, usually 1-septate, colour various.	
Foliose, rarely subfruticose	49. **Physcia.**
Squamulose or crustaceous	50. **Rinodina.**

45. **TELOSCHISTES** Norm. (*Physcia* Schreb. pro parte).—Fruticose, brightly coloured, upright or decumbent, the fronds branched, cylindrical or compressed, attached at the base; structure radiate; cortex of longitudinal hyphæ (fibrous). Apothecia discoid, sessile; hypothecium colourless with underlying gonidia; paraphyses simple or branched at the apices, septate; spores 8, polarilocular, colourless.

The genus has been separated from *Physcia* on account of the fruticose thallus and the colour of the spores. There are only two species in Britain, both of a beautiful golden colour varying to green in the shade. On trees, rocks or walls, chiefly in maritime districts.

Almost filamentous, long, bushy	1. T. flavicans Norm.
Short, strap-shaped, rigid	2. T. chrysophthalmus Th. Fr.

46. **XANTHORIA** Th. Fr. (*Physcia* Schreb. pro parte). — Foliose, horizontal or subascending, lobate, brightly coloured, sometimes sorediate, beneath more or less rhizinose and generally paler; cortex of plectenchyma on both surfaces. Apothecia scattered, discoid, moderate in size; hypothecium colourless with underlying gonidia; paraphyses branched and septate near the tips; spores 8, 1-septate, polarilocular, colourless. Spermogones immersed in small tubercles.

Differs from *Physcia*, in which the species have often been included, in the colour of thallus and spores. The species grow most freely in maritime districts, and are bright-yellow in the open where the acid substance parietin (K + crimson or purple) is freely formed, or almost green in the shade. The apothecial discs as in the allied genera are the most deeply coloured parts of the lichen.

Orbicular, lobate. C.	1. X. parietina Th. Fr.
More monophyllous and wrinkled, deeply coloured	Var. aureola Th. Fr.
More broken up, deeply coloured	Var. ectanea Oliv.
Poorly developed, often in masses. Apo. numerous. F.	2. X. polycarpa Oliv.
Straggling, subascending, margins pulverulent. F.	3. X. lychnea Th. Fr.

47. **PLACODIUM** DC. emend Hepp.— Thallus squamulose with a definite, somewhat circular outline (effigurate) and corticate above (rarely also below), or crustaceous and effuse, mostly yellow, rarely whitish, greyish, or dark-grey, mostly K + crimson or purple. Apothecia brightly coloured, rarely dark-brown, generally with a thalline margin, in some species with a proper margin only; paraphyses slender, broader and septate and often freely branched at the tips, the epithecium generally deeply suffused with parietin; spores colourless, 1-septate (very rarely simple), polarilocular.

Parietin is produced in more or less abundance in the thallus of most species, and in the apothecia of all except *Pl. repellens* which is probably an impoverished form. The thalline margin of the apothecium in some species is reduced to a zone of gonidia below the hypothecium; in a few others it is absent, though other characters secure their inclusion in the genus. The spores are imperfectly polarilocular in *Pl. nivale*, and simple in *Pl. fulgens* and *Pl. rupestre*.

Species with squamulose and crustaceous thalli are included in the genus as they grade into each other. Distinctive differences are indicated by the division into sections, the more highly developed forms being placed first.

Apothecia with a more or less prominent thalline margin.	
Thallus squamulose-effigurate	§ i. EUPLACODIUM.
Thallus crustaceous	§ ii. CALLOPISMA.
Apothecia without an apparent thalline margin.	
Thallus crustaceous	§ iii. BLASTENIA.

§ i. EUPLACODIUM.—Yellow or orange, entirely or partly lobate. Mostly on rocks or walls.

*Thallus entirely lobate.	
†Spores simple or imperfectly septate. On mosses or soil	1. Pl. fulgens S. F. Gray.
††Spores polarilocular. On rocks or walls.	
Spores wide in relation to length (8–16 μ × 6–10 μ).	
Flat at circumference. C.	2. Pl. callopismum Mér.
Turgid-convex at circumference. C.	3. Pl. flavescens A. L. Sm. (*Lecanora callopisma* Var. *sympagea* Nyl.)
Spores ellipsoid, narrower (varying 9–18 μ × 4–8 μ).	
Narrow, convex, irregular, deeply coloured. Alpine	4. Pl. elegans DC.
Narrow, convex, stellate, dark coloured. R.	5. Pl. dissidens Nyl.
Broader, convex, centre almost plane and often brown. F.	6. Pl. murorum DC.
Lobes less developed, in crowded groups.	Var. pusillum Flag. (*L. tegularis* Nyl.)
**Lobes narrow, the centre granular.	
Convex, rather apart; centre isidiose. S.	7. Pl. granulosum Hepp.
Contiguous, convex; centre areolate-warted. R.	8. Pl. scopulare Oliv.
Convex; centre areolate, often brown. S.	9. Pl. decipiens Leight.
Convex, yellow-sorediate; centre areolate. F.	10. Pl. cirrochroum Hepp.
***Thallus orbicular, leprose, sterile. F. ...	11. Pl. xantholytum Nyl.
****Lobes minute, mostly scattered.	
Contiguous, rounded, smooth. Maritime. C.	12. Pl. lobulatum A. L. Sm.
Thin, cracked-areolate, tawny-red. S.	13. Pl. miniatum Oliv.

§ ii. CALLOPISMA.—Crustaceous. Apothecia mostly yellow or orange; the thalline margin sometimes disappearing; spores polarilocular, except in *Pl. nivale.*

*Yellow or greenish-yellow, K + cr.	
Abundant, granular-furfuraceous, areolate. Rocks. C.	14. Pl. citrinum Anzi.
Thin, furfuraceous. Apo. bright-yellow. Trees. F.	15. Pl. phloginum A. L. Sm.
Thickish, areolate, not furfuraceous. Rocks. R.	16. Pl. incrustans A. L. Sm.
Membranaceous. Apo. dark-orange; sp. broadly ellipsoid. Trees. C.	17. Pl. aurantiacum Anzi.
More distinctly areolate or very scanty. Rocks. C.	Var. flavovirescens Anzi. (*Lecanora erythrella* Ach.)
Apo. very deeply coloured. Rocks	Var. alpinum Anzi.
Thin. Apo. with crenulate margin. Rocks. R.	18. Pl. crenulatellum A. L. Sm.
**Greyish-white, K + cr. Apothecia various.	
Thin, membranaceous. Apo. yellow, whitish margin. Trees. C.	19. Pl. cerinum Hepp.
Leprose. Apo. more olive-green. Mosses. C.	Var. stilicidiorum Hepp.
Scanty, granular-leprose. Apo. margin disappearing. Rocks or wood. C.	20. Pl. pyraceum Anzi.
Evanescent. Sp. short and broad	Var. pyrithromum A. L. Sm.
Thickish, bluish-grey, smooth, areolate. Apo. dark. Rocks. F.	21. Pl. chalybaeum Naeg.
Thinner. Apo. dark, grey-pruinose. Rocks. F.	22. Pl. variabile Nyl.
***Greyish-white, K –.	
Membranaceous. Apo. dark-brown. Trees. R.	23. Pl. phæocarpellum A. L. Sm.
Membranaceous. Apo. reddish, K –. Poplars. R.	24. Pl. refellens A. L. Sm.
Thickish, furfuraceous, areolate. Sp. broadly ellipsoid. Rocks. F.	25. Pl. erythrocarpum A. L. Sm. (*Lecanora teicholyta* Ach.)
****Whitish; reaction with K various.	
Thickish, smooth, areolate, K –. Sp. small. Rocks. R.	26. Pl. Lallavei Oliv.
Thin furfuraceous, K –. Sp. broadly ellipsoid. Rocks. R.	27. Pl. albolutescens A. L. Sm.
Minutely granular, K + cr. Sp. fusiform, subsimple. Alpine rocks. R.	28. Pl. nivale Tuckerm.
*****Mostly dark-grey or blackish, K + cr, p, or K –.	
Effuse, wrinkled or areolate, K + cr. Apo. rusty-red. Bark. R.	29. Pl. hæmatites A. L. Sm.

Thickish light or dark-grey, K+p. Apo. rusty-red, margin disappearing. Rocks. F. .... 30. Pl. cæsiorufum A. L. Sm.
Thin, K + p. Apo. rusty-red, margin persistent. Rocks. R. 31. Pl. fuscoatrum A. L. Sm.
Thickish, areolate, K –. Apo. brownish-black. Alpine rocks. R. .... 32. Pl. concilians A. L. Sm.

§ iii. Blastenia.—Crustaceous. Apothecia mostly highly coloured, without a thalline margin; spores polarilocular except in *Pl. rupestre*.

*Yellowish, K + cr.
Thinly felted continuous, ochraceous. Rocks. R. .... 33. Pl. ochraceum Anzi.
Thinly felted or areolate, ochraceous. Sp. contents broken up 34. Pl. tetrastichum A. L. Sm.
Effuse, faintly areolate, yellow. Sp. small. Rocks. R. .... 35. Pl. vitellinulum A. L. Sm.

**Greyish-white. Reaction with K various.
Mostly thin, unequal or areolate, K + p. Apo. rusty-red. Trees. C. .... 36. Pl. ferrugineum Hepp.
Very slight K reaction. Rocks. C. .... Var. festivum A. L. Sm.
Greyish-white, K –. Apo. brick-red to black. On trees. R. ......, 36a. Pl. Pollinii A. L. Sm.
Thin, areolate, Kf + y. Apo. yellow, K + p; sp. 8, 12, 16 in ascus. Trees. R. .... 37. Pl. cerinellum A. L. Sm.
Effuse, furfuraceous, K –. Apo. orange, K + cr; sp. small, septum thin. Trees. C. .... 38. Pl. luteoalbum Hepp.
Thallus in scattered granules. Stones, etc. C. .... f. rupestre A. L. Sm.
Thin, areolate, K –. Apo. yellow or dull-red, K + p; sp. simple. Rocks. C. 39. Pl. rupestre Branth. & Rostr. (*Lecanora irrubata* Nyl.)
Apo. in pits. Cal. C. .... Var. calvum A. L. Sm.

***Blackish. Reaction with K various.
Thin, K –, smooth warts on black hypothallus. Apo. orange. Rocks. R. .... 40. Pl. atroflavum A. L. Sm.
Thin or thickish, areolate, Kf + p. Apo. orange or brown. Rocks. R. 41. Pl. Turnerianum A. L. Sm.

48. **CANDELARIELLA** Müll.-Arg. (*Lecanora* subgen. *Candelaria* Nyl. pro parte).—Crustaceous, granular, sometimes lobed at the circumference (effigurate), yellow. Apothecia sessile, yellow, with a thalline margin; hypothecium colourless, with gonidia underneath; paraphyses unbranched, occasionally septate and wider towards the apex; spores 8 or many, colourless, ellipsoid, simple or becoming 1-septate and sometimes polari-

locular. Spermogones minute, with septate forked or branched sterigmata and acrogenous spermatia.

The yellow thallus and apothecia in this genus contain no parietin and give no reaction with potash. The spores however indicate its affinity with Physciaceæ. *C. vitellina* on rocks, palings, etc., is common, the other species, on rocks or walls, are rare.

Thallus lobate at the circumference.
  Spores many in the ascus .... 1. **C. crenata** A. L. Sm.
  Spores 8 in the ascus .... 2. **C. medians** A. L. Sm.
Thallus granular.
  Spores many in the ascus .... 3. C. vitellina Müll.-Arg.
  Spores 8 in the ascus .... 4. **C. epixantha** A. L. Sm.

49. **PHYSCIA** Schreb.—Thallus rarely fruticose; more generally foliose and horizontal, whitish, grey, greyish-green or brown, sometimes sorediate, attached mostly by rhizinæ. Structure radiate, subradiate or dorsi-ventral. Apothecia discoid, small or moderate in size, blackish, with a thalline margin; hypothecium brownish or dark; paraphyses simple or branched near the brown tips; spores 8, two-celled, with a thick outer wall and thickish septum, more or less distinctly polarilocular, dark-brown.

There is considerable variation in the structure of the thallus; species of radiate structure are surrounded by a cortex which is formed of hyphæ parallel with the long axis of the frond. This type of cortex termed "fibrous" occurs also in most of the horizontal species, in some being confined to the upper surface, in others to the lower, while in a few both cortices are of plectenchyma. Species with a fibrous upper cortex are placed by some authors in a separate genus, *Anaptychia*. *Physcia* with horizontal lobes are sometimes velvety or pruinose. (Fig. on p. 51.)

On trees or rocks. Colours other than greyish-green are indicated.

*Cortex fibrous above, or on both surfaces (*Anaptychia*).
  Thallus fruticose or partly ascending, of narrow fronds.
    Corticate on both surfaces, upright. R. ... 1. Ph. intricata Schær.
    Corticate above, mostly decumbent, grey-ciliate. C. .... 2. **Ph. ciliaris** DC.
    Whitish, corticate above, dark-ciliate F. in south .... 3. **Ph. leucomela** Mich.
  Thallus horizontal, fibrous-corticate on both surfaces.
    Dark-brown, narrow. Maritime. C. ... 4. **Ph. fusca** A. L. Sm. (*Ph. aquila* Nyl.)
    Grey, with apical soredia K + y. F. ... 5. Ph. speciosa Nyl.
      Apo. margin leafy. R. .... Var. hypoleuca Nyl.
**Cortex fibrous on lower surface, plectenchymatous above.
    Thickish, crumpled, pruinose K −, dark beneath. C. .... 6. **Ph. pulverulenta** Nyl.
      Brownish. Apo. margin leafy (coronate) Var. venusta Oliv.
    Thinner, pruinose K −, sorediate at margins. C. .... 7. **Ph. grisea** A. Zahlbr.

Stellate, contiguous, subconvex, whitish beneath K + y. C.	8. Ph. stellaris Nyl.
Flattened at circumference. C.	Var. aipolia Nyl.
Coarser, irregular, wrinkled. C.	Var. cercidia Th. Fr.
Narrow, appressed, brownish beneath. R.	9. Ph. melops Duf.
Narrow, grey, ciliate, often arched and sorediate at tips. C.	10. Ph. hispida Tuckerm. (*Ph. stellaris* Vars. *leptalea* Nyl. and *tenella* Nyl.)
Suborbicular, thin, appressed, sorediate at centre. F.	11. Ph. astroidea Nyl.
Orbicular, with scattered soredia. C.	12. Ph. cæsia Nyl.
Thin, orbicular, closely appressed, sorediate when old. F.	13. Ph. elæina A. L. Sm. (*Ph. adglutinata* Nyl.)
***Cortex of plectenchyma on both surfaces.	
Suborbicular, thin, eroded, often powdery-sorediate. F.	14. Ph. erosa Leight.
Suborbicular, with sorediate pustules. R.	15. Ph. tribacia Nyl.
Brownish, irregular, spreading, yellow medulla and soredia. R.	16. Ph. subdetersa Nyl.
Brown, subcrustaceous, edges black-rhizinose. R.	17. Ph. orbicularis Dalla Torre & Sarnth. (*Ph. obscura* Nyl.)
Cilia on under side of apothecia	Var. ciliata Dalla Torre & Sarnth. (*Ph. ulothrix* Nyl.)
Green and often suffused by *Xanthoria parietina*.	Var. virella Dalla Torre & Sarnth.
Dark multifid laciniæ, rhizinose at edges. R.	18. Ph. lithotea Nyl.

50. **RINODINA** Massal.—Crustaceous, rarely squamulose, non-corticate except in highly developed species. Apothecia dark-coloured, generally with a prominent thalline margin; paraphyses slender, septate, brown and often shortly branched at the broader tips; spores 8 (rarely more), 1-septate, more or less distinctly polarilocular, brown.

The spores of this genus, as in *Physcia*, are nearly always distinctly polarilocular, with the cell-lumen however near the median wall.

*Isidioid-squamulose, grey.	
Bluish-grey. Sp. up to $30 \times 15\ \mu$. On trees. R.	1. R. isidioides Koerb.
**Crustaceous. Grey or whitish.	
On trees or wood.	
Thin, granular. Apo. minute; sp. 24. R.	2. R. polyspora Th. Fr.
Warted-areolate. Apo. small, plane. F.	3. R. sophodes Th. Fr.
Thin areolate. Apo. small, convex margin crenulate. F.	4. R. exigua S. F. Gray.
Thin continuous K + y. Apo. larger, margin crenulate. C.	5. R. roboris Arn.
On rocks, slates, tiles, etc.	
Thickish, warted. Apo. small, margin crenulate. F.	6. R. confragosa Koerb.

Smooth warts on black hypothallus K + y. Apo. minute. F. .... 7. R. atrocinerea Koerb.
Thin, areolate. Apo. minute, plane. R. 8. R. subexigua Arn.
Thin, smooth Kf + y. Apo. *Lecidea*-like. R. .... 10. R. æquata Oliv.
Thin, farinose. Apo. small, plane. Cal. R. .... 11. R. Bischoffii Koerb.
Immersed. Apo. in pits.......... Var. immersa Koerb.
Thin, smooth. Apo. minute; sp. up to 30 × 15 μ. R. .... 12. R. subarenaria A. L. Sm.

***Crustaceous, dark-grey or blackish.
On trees.
Thin, pulverulent. Apo. minute. R.... 13. R. colobina Th. Fr.
On rocks.
Thickish, granular. Apo. small; sp. up to 27 × 16 μ. F. .... 14. R. teichophila Jatta.
Thickish, granular. Apo. small; sp. up to 20 × 12 μ. R. .... 15. R. milvina Th. Fr.
Thin, in small patches. Apo. minute. R. 16. R. umbrinofusca Oliv.
Thick, smooth, unequal. Apo. convex. R. .... 17. R. coniopta A. L. Sm.
On turf.
Thin, scurfy. Apo. small; sp. up to 35 × 15 μ (? 3-septate). R. .... 18. R. Conradi Koerb.

FAMILY XIII. LECANORACEÆ.

Thallus crustaceous or squamulose, variously coloured. Structure more or less stratose, corticate above or non-corticate, attached by hyphæ to the substratum. Algal cells Protococcaceæ, very rarely *Trentepohlia*. Apothecia superficial or sometimes immersed at first in the thallus, discoid, normally with a prominent thalline margin; spores 8, or many, in the ascus, colourless, simple or variously septate. Spermogones with acrogenous or pleurogenous spermatia.

A large and widely distributed Family. It is distinguished from the somewhat parallel Lecideaceæ by the character of the apothecia, in the development of which the thallus takes part and forms a protective margin generally of the same colour round the disc. The term granulate thallus indicates that the granules have become somewhat coherent and smooth, as if corticate. Warts are still larger tumid units.

Spores simple.
8 or few in the ascus.......... 51. **Lecanora.**
Many in the ascus.......... 52. **Acarospora.**
Spores septate.
Elongate-ellipsoid, 1–2-septate .... 53. **Lecania.**
Elongate-fusiform, 1–3-septate .... 54. **Icmadophila.**
Elongate-acicular, pluri-septate .... 55. **Hæmatomma.**

51. **LECANORA** Ach.—Squamulose or variously crustaceous, rarely somewhat minutely fruticose, attached to the substratum by hyphæ, the cortex of the upper surface of decomposed hyphæ or wanting. Algal cells

Protococcaceæ. Apothecia generally superficial, discoid, with a thalline margin; hypothecium mostly colourless, generally with a layer of algæ beneath; spores usually 8, simple, colourless, mostly ellipsoid.

The genus as here understood includes only species with simple colourless spores, generally 8 in the ascus (up to 32 in *L. Sambuci*); they are described as small if up to 12 × 6 μ, as moderate up to 18 × 7-10 μ, and as large if beyond that size.

Squamulose	§ i. SQUAMARIA.
Crustaceous or indistinctly squamulose.	
Apothecia superficial from the first.	
Spores less than 40 μ long	§ ii. EULECANORA.
Spores very large with thick epispore	§ iii. OCHROLECHIA.
Apothecia immersed at first	§ iv. ASPICILIA.

§ i. SQUAMARIA DC. (as genus).—Thallus more or less squamulose, imbricate, or appressed, orbicular and effigurate (with definite outline; see also *L. polytropa*). The species grow mostly on rocks, more rarely on soil (*L. cartilaginea* and *L. lentigera*), or also rarely on palings (*L. muralis*).

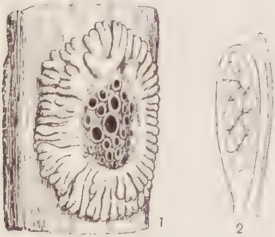


FIG. 32.—*Physcia stellaris* Nyl. var. *aipolia* Nyl. 1. Plant on bark. 2. Ascus and spores (dark-brown) with paraphysis × 500.

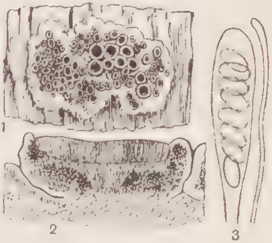


FIG. 33.—*Lecanora varia* Ach. 1. Plant on paling. 2. Vertical section of thallus and apothecium × 50. 3. Ascus with spores and paraphyses × 500.

Squamules imbricate.	
Sq. broad, thick, irregular, brown. C.	1. L. cartilaginea A. L. Sm. (*L. crassa* Ach.)
Sq. narrower, light-greenish-yellow. R.	2. L. Achariana A. L. Sm. (*L. cartilaginea* Ach.)
Squamules appressed, effigurate at circumference.	
Squamulose at centre, whitish. R.	3. L. lentigera Ach.
Continuous at centre, whitish straw-coloured. Alpine. R.	4. L. chrysoleuca Ach.
Continuous at centre, powdery, whitish. R.	5. L. pruinosa Chaub.
Cartilaginous, areolate at centre, whitish to grey, with reddish flat cephalodia. C.	6. L. gelida Ach.

Crustaceous-areolate at centre, brownish, or greenish-yellow. C.	7.	L. muralis Schær. (*L. saxicola* Ach.)
Almost entirely crustaceous...............		Var. diffracta Schær.
Scanty, powdery-white		Var. versicolor Tuckerm.
Crustaceous-areolate at centre, grey, K + y, then red. R.	8.	L. subimbricata A. L. Sm. (*L. circinata* Ach.)

§ ii. EULECANORA Th. Fr.—Crustaceous. Apothecia superficial; paraphyses generally simple, not intricately branched.

The groups into which *Eulecanora* are divided are marked either by thalline or apothecial characters. Apothecia vary from small (about 5 mm. in diam.) to moderate size (about 1–2 mm. in diam.).

Whitish or cinereous grey.			
Apo. reddish-brown, or rarely black......	A.	Subfusca group. ..	11–20.
Apo. dull-brown..................................	B.	Hageni group.	21–26.
Apo. pruinose....................................	C.	Pallida group.	27–35.
Greenish-grey....................................	D.	Varia group..........	36–38.
Pale-yellowish-grey	E.	Symmicta group....	39–45.
Yellow or pale-yellow	F.	Sulphurea group....	46–53.
Dark-coloured	G.	Badia group..........	54–59.

A. **Subfusca** group.—Variously crustaceous, grey or whitish, K + y. Apothecia moderate in size, the disc reddish-brown, rarely paler or becoming black; spores small or moderate in size. Thalline reactions may be very slight.

*Apothecia reddish-brown.		
On trees (*L. epibryon* on mosses).		
Grey, thin (especially at the circumference).		
Apo. margin mostly entire. R....	11.	L. subfusca Ach.
Margin crenate. Apo. furrowed below. C.		Var. chlarona Ach.
Margin prominent, generally entire. C.		Var. pinastre Schær.
Margin flexuose. Apo. larger, often crowded. C.		Var. allophana Ach.
Thallus determinate		f. parisiensis Hue.
Grey, thin. Apo. small, margin disappearing. R.	12.	L. fuscescens Nyl.
Grey or whitish, thickish. Apo. with crenulate margin. C.	13.	L. rugosa Nyl.
Whitish, granular. On mosses. R.	14.	L. epibryon Ach.
Whitish, thin, smooth or wrinkled. Apo. margin thick. S.	15.	L. intumescens Koerb.
Whitish or grey, granular. Apo. pale-brick-red (sometimes large). S.	16.	L. chlarotera Nyl.
On rocks.		
Grey, thickish, granular. Apo. red-brown. C.	17.	L. campestris B. de Lesd.

- **Apothecia brownish-black or black.
  - Generally on rocks.
    - Whitish or grey, granular-areolate. Apo. brownish-black. C. .... 18. L. coilocarpa Nyl.
    - Greyish, warted-areolate. Apo. black. F. .... 19. L. gangaleoides Nyl.
      - Thinner, determinate, smooth or wrinkled. R. .... Sub-sp. schistina Nyl.
    - Grey or whitish, crowdedly granulate. Apo. violet within. C. .... 20. L. atra Ach.

B. **Hageni** group.—Thin or scanty, whitish or greyish, K –. Apothecia small, the disc dull-brown; spores 8 or many, mostly small.

- *Ascus 8-spored.
  - On wood, pales or weeds.
    - Apo. pale, crowded, subpruinose. F. .... 21. L. Hageni Ach.
      - With prominent white margin. On *Zostera*. R. f. Zosteræ A. L. Sm.
  - On rocks.
    - Apo. more umber-brown, not pruinose. F. .... 22. L. umbrina Massal.
    - Apo. small, margin crenulate; sp. up to 16 μ long. F. ..... 23. L. crenulata Nyl.
    - Apo. small, in groups. R. ...... 24. L. conferta Nyl.
    - Apo. brownish-black; epi. No$_3$ + rose. R. .... 25. L. Agardhiana Ach.
- **Ascus many-spored. (On trees, rarely on pales.)
  - Apo. minute, pale or reddish-brown. R. .... 26. L. Sambuci Nyl.

C. **Pallida** group.—Whitish, yellowish or rarely greyish. Apothecia pruinose. Spores small or moderate in size.

- *Thallus K + yellow.
  - †Whitish or greyish-white, generally thin. On trees.
    - Apo. pale, generally pruinose. C. 27. L. pallida Schær. (*L. albella* Ach.)
    - Apo. light or dark, white-pruinose, disc C + y. C. 28. L. carpinea Wain. (*L. angulosa* Ach.)
  - ††Whitish or greyish, thicker. On rocks.
    - Apo. dull-reddish, bluish-black-pruinose, disc C + y. C. 29. L. sordida Th. Fr. (*L. glaucoma* Ach.)
    - Apo. yellow, brown or black, grey-pruinose. R. .... 30. L. cenisia Ach.
    - Apo. dark, scarcely pruinose. F. Var. atrynea Harm.

**Thallus K + yellow then red.
Thickish, yellowish-white. On rocks.
Apo. pale - reddish, whitish-pruinose. R. .... 31. L. subcarnea Ach.
Apo. brown then blackish, whitish-pruinose. R. ...... 32. L. præpostera Nyl.
***Thallus K −.
Thickish, whitish. Cal. or mortar.
Apo. pale - brown, crowded, pruinose or naked. C....... 33. L. galactina Ach.
Thin. Apo. scattered, small — Sub-sp. dispersa Nyl.
Apo. in pulvinate groups, white-pruinose. R. .... 34. L. urbana Nyl.
****Thallus K(C) + red. Indistinct. Apo. scattered. R. .... 35. L. Andrewsii B. de Lesd.

D. **Varia** group.—Greenish-grey. Apothecia moderate or rather large, the disc greenish or greenish-brown ; spores moderate in size.

On trees or pales.
*Thallus K −.
Thin, warted-granular. Apo. numerous. C. .... 36. L. varia Ach.
**Thallus K + y.
Thick, pulverulent - areolate. Apo. margin pulverulent. C. 37. L. conizæa Nyl.
Less pulverulent. Apo. margin crenulate. R. .... Var. conizæoides A. L. Sm.
***Thallus K + yellowish-brown.
Granular-areolate or smooth. Apo. dull-brown. R. .... 38. L. sublivescens A. L. Sm.

E. **Symmicta** group. Finely granular, scanty, pale-yellowish-grey. Apothecia generally small, the thalline margin often disappearing, mostly pale then becoming dark ; spores rather small.

On pales. (*L. piniperda* on firs ; *L. fugiens* on rocks.)
*Apothecial margin disappearing.
K + y, C + o.
Apo. scattered or crowded. R. ..... 39. L. symmicta Ach.
Becoming almost black .... Var. sæpincola Nyl.
K + y, C − (*L. subimbricata* K −).
Apo. crowded or confluent. C. ...... 40. L. symmictera Nyl.
Th. more developed. Apo. blackish .... Var. aitema Nyl.
Apo. yellowish, brown or dark-olive. R. .... 41. L. subimbricata Th. Fr.
Apo. dull-brown or blackish ; sp. narrow. F. .... 42. L. sarcopisioides A. L. Sm.
Apo. brown, margin crenulate (incl. *L. sarcopis*). F. .... 43. L. effusa Ach.
**Apothecial margin persistent.
Finely felted Kf + y. R. .... 44. L. piniperda Koerb.
Finely granulate K + y, C + o. R. ..... 45. L. fugiens Nyl.

F. **Sulphurea** group.—Leprose, granular, warted or subsquamulose, yellow, greenish- or whitish-yellow. Apothecia light or becoming dark; spores moderate in size.

On trees.
Pulverulent C + o-red or brownish. Apo. pale. F. .... 46. L. expallens Ach.
More granulate .... Var. lutescens Nyl.
On rocks (*L. intricata* rarely on wood).
*Crustaceous.
Thin, areolate K + y-brown. Apo. few, pale to blackish. R. ...... 47. L. orosthea Ach.
Granular-areolate K + y-brown. Apo. blackish. C. .... 48. L. sulphurea Ach.
Granular-warted, sorediate K –. Apo. brownish. R. .... 49. L. epanora Ach.
Thin, variable Kf + y. Apo. yellow or reddish. C. .... 50. L. polytropa Schær.
**Subsquamulose-effigurate Kf + y.
Subsquamulose or evanescent ...... 50. L. polytropa Schær.
Thickish. Apo. pale then olive or black. F. .... 51. L. intricata Ach.
Thin on black hypothallus. Mosses. R. .... Var. leptacina Stizenb.
Scattered warts. Apo. dark. R.... 52. L. frustulosa Ach.
Thickish, granular-areolate. Apo. dark. F. .... 53. L. argopholis Ach.

G. **Badia** group.—Thallus dark-coloured K –. Apothecia dull-brown or black, generally small; spores generally rather small. All on rocks.

*Dark-brown or almost black, subsquamulose or warted.
Spores fusiform 10–16 × 4–6 μ. C. 54. L. badia Ach.
Thallus black. R. .... Subsp. picea Nyl.
Spores almost globose. Alpine. R. 55. L. austera Nyl.
Spores oblong, 9–18 × 3–5 μ. R. 56. L. nitens Ach.
**Reddish-brown, of scattered granules.
Spores ellipsoid. On *Rhizocarpon geographicum*. R. .... 57. L. atriseda Nyl.
***Greyish mouse-brown, areolate.
Spores ellipsoid. Moist rocks, Alderney. R. .... 58. L. torquata Nyl.
****Greyish-brown of closely packed papillæ.
Spores ellipsoid. R. .... 59. L. poliophæa Ach.

§ iii. OCHROLECHIA Massal. (as genus).—Thallus crustaceous, whitish, or grey. Apothecia generally large (up to almost 1 cm. diam.), with a tumid or prominent margin; paraphyses long, slender, branched and intricate; spores 8, usually very large. (2 in *L. geminipara*.)

The species of this section often form wide-spreading, thickish or thin crusts on rocks, trees, or mosses on the ground. *L. tartarea* and *L. parella* are well-known dye-lichens, yielding on treatment a purple dye. The former is known as the cudbear lichen.

*Grey. Apothecial disc not pruinose.	
Tartareous, thick K + y, C + red. Apo. C. + reddish. C.	61. L. tartarea Ach.
Partly sorediate	Subsp. subtartarea Nyl.
**Whitish. Apothecial disc more or less pruinose.	
Scattered warts, K + y to red, with soredia C + red. R.	62. L. geminipara Th. Fr.
Smooth, cracked K –. Apo. disc K(C) + red. C.	63. L. parella Ach.
More or less sorediose	Var. Turneri Nyl.
Mostly thin K –. Apo. disc and margin K(C) + red. Trees. R.	64. L. pallescens Nyl.
Continuous or scattered. Apo. K(C) –. Mosses. R.	65. L. upsaliensis Nyl.

§ iv. Aspicilia Massal. (as genus). Variously crustaceous. Apothecia innate in the thallus, then usually emergent, the thalline margin persistent or disappearing, the proper margin often prominent; hypothecium generally colourless; paraphyses slender, usually densely septate, and often bead-like (moniliform) towards the tips: spores ellipsoid, rather large, or more rarely small.

The apothecia in this subgenus develop primarily as *Lecidea* with a proper margin only, the thalline margin, which is often prominent and persistent, grows up later around the apothecium. In other respects the fruits are lecanorine. *Lecanora Dicksonii* and *L. pelobotrya* are retained for convenience of reference, but belong more truly to *Lecidea*. The two groups differ in the character of the gonidia:—

A. Euaspicilia. Algal cells *Protococcaceæ*.
B. Jonaspis. Algal cells *Trentepohlia*.

A. **Euaspicilia.**—Algal cells Protococcaceæ.

*Thallus crustaceous. On rocks.	
†Whitish or cinereous-grey, K + y, then red.	
Determinate, ashy-grey, areolate. Sp. up to 23 × 16 μ. C.	66. L. cinerea Sommerf.
Determinate, whitish, areolate. Sp. up to 34 × 15 μ. R....	67. L. intermutans Nyl.
Cracked into warted areolæ, dark. Sp. up to 13 × 8 μ. R.	68. L. alpina Sommerf.
††White or whitish-grey, K –.	
Cracked-areolate. Sp. 18–30 × 14–27 μ. C.	69. L. calcarea Sommerf.
Of scattered rounded squamule-like areolæ.....................	Var. contorta Hepp.
Of crowded squamule-like areolæ	Var. Hoffmanni Sommerf.
Large rounded scattered warts. Sp. up to 35 × 16 μ. Alpine. R.	70. L. pelobotrya Sommerf.
**Grey, isidia-like warts, K –. On rocks or on mosses.	
Squamulose-warted. Sp. up to 62 × 30 μ. R.	71. L. verrucosa Laurer.

Thin. Apo. 3–4 on warts. Sp. up to 80 × 50 μ. (Rarely mosses on bark.) R. .... 72. L. poriniformis Nyl.
Thin, of crowded papillæ. Sp. up to 35 × 20 μ. Alpine. R. 73. L. leucophyma Nyl.

***Thallus grey or brownish-grey, warted or areolate, K –. On rocks.
†Spores large (20–35 μ long or more, up to 25 μ thick).
Thickish warts on black hypothallus. C. .... 74. L. gibbosa Nyl.
Determinate-zonate. R. ...... Var. zonata Wain.
Thickish, irregularly areolate. Apo. often confluent. F.... 75. L. cæsiocinerea Nyl.
Smoother and very dark. R. f. obscurata Nyl.
Thickish, areolate. Apo. dark-red (not recorded)............ 76. (L. cinereorufescens Nyl.)
Thallus rusty-red. Alpine. R. f. diamarta Nyl.
††Spores small (less than 15 μ long).
Thallus mostly determinate, thick, areolate.
Apo. with prominent margin; paraph. moniliform. R. 77. L. recedens Nyl.
Apo. with thin margin; paraph. clavate. R. ..... 78. L. decincta Nyl.

****Thallus dark in colour, wrinkled or areolate, K –. Apo. small. On rocks.
†Spores large (16–30 μ long); paraph. septate, not generally moniliform.
Membranaceous, olive-grey. Paraph. moniliform. R.... 79. L. lusca Nyl.
Cracked, dark-grey, smooth or wrinkled. R. .... 80. L. subdepressa Nyl.
Plane, cracked, olive-brown, K(CaCl) + reddish. R. ..... 81. L. Bockii Th. Fr.
††Spores small (less than 15 μ long).
Brownish, areolate-subsquamulose. R. .... 82. L. complanatoides A. L. Sm.
Brown or grey, of small squamulose areolæ. R. .... 83. L. superiuscula Nyl.
Black, of minute areolæ. Apo. minute. R. .... 84. L. morioides A. L. Sm.

*****Thallus often continuous, thin, K –. Apo. immersed or innate. On rocks.
Olivaceous, shining. Apo. black; paraph. moniliform; sp. 15–24 × 9–16 μ. Moist rocks. R. 85. L. lævata Nyl.

Pale reddish or yellowish. Apo. pale; sp. 13–18 × 6–9 μ. In streams. C. .... 86. L. lacustris Th. Fr.
Rusty-red, finely cracked. Apo. black, *Lecidea*-like; sp. 11–14 × 6–8 μ. C. .... 87. L. Dicksonii Nyl.
Ochraceous, felted. Apo. black; sp. 12–18 × 7–11 μ. R. ... 88. L. flavida Hepp.
Tawny-yellow, in patches. Apo. light; sp. 8–12 × 4–5 μ. R. 89. L. fulvo-mellea A. L. Sm.
Light-coloured, tartareous, thin. Apo. pale, immersed; sp. 14–22 × 9–11 μ. R. .... 90. L. Prevostii Th. Fr.
Apo. minute, emergent...... Var. affinis Nyl.

B. **Jonaspis.**—Algal cells *Trentepohlia*, the gonidia distinguished by their large size.
On rocks. R.
Thin, whitish to pale-reddish. Sp. up to 20 μ long. .... 91. L. epulotica Nyl.
Thin, reddish, dark-green when dry. Sp. up to 12 μ long............ .... 92. L. chrysophana Nyl.

52. **ACAROSPORA** Massal.—Squamulose or crustaceous, generally rather thick, the squamules scattered, or contiguous in areolæ, corticate above or non-corticate. Apothecia generally immersed, then plane, discoid, the thalline margin becoming indistinct; hypothecium colourless; paraphyses slender, septate; spores many in the ascus, mostly very small, oblong or ellipsoid, colourless.

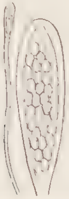


FIG. 34.—*Acarospora squamulosa* Th. Fr. Ascus with spores and paraphysis × 250.

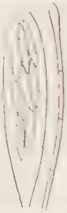


FIG. 35.—*Lecania syringea* Th. Fr. Ascus with spores and paraphysis × 500

Distinguished by the many-spored asci, and thus corresponding with the genus *Biatorella* (Lecideaceæ). The species *L. pruinosa*, *L. simplex*, etc., included sometimes under *Acarospora*, sect. *Sarcogyne*, have no gonidia in the fruiting body and belong to *Biatorella*. On rocks, rarely on soil. The thallus is K – C –, unless otherwise indicated.

*Squamulose, thickish.
†Squamules pale beneath.
Spores up to 12 μ long. Cal. R. .. 1. A. squamulosa Th. Fr.
Spores 6 μ long or less.

Sq. dark-brown. On soil. R.	2. A. Benedarensis Knowles.
Sq. yellow or dull-brown. R.	3. A. glaucocarpa Koerb.
Reduced or obsolete apo., often pruinose	Var. depauperata Jatta.
Sq. fawn-coloured (Kf + y, then red). Sp. minute. R.	4. A. Lesdainii Harm.
Sq. brown, whitish - pruinose. Cal. R.	5. A. percænoides Jatta.
††Squamules dark beneath, K(C) + reddish.	
Dull - brown. Apo. small, disc smooth. C.	6. A. fuscata Th. Fr.
Dull-brown, areolate. Apo. larger, disc granular-papillate. R.	7. A. peliocyphoides Oliv.
†††Squamules dark beneath, K(C) –.	
More or less scattered tawny or reddish. F.	8. A. smaragdula Massal.
Bright rusty-red. F.	Var. sinopica Massal.
Crowded, tawny-brown. Apo. disc granular-papillate. R.	9. A. peliocypha Th. Fr.
**Crustaceous granular or effuse, mostly dark.	
Deeply cracked, dark. Apo. small, reddish. Maritime. R.	10. A. rhagadiza Oliv.
Warted-areolate. Apo. dark-brown. Uplands. R.	11. A. discreta Th. Fr.
Effuse, dull-yellowish. Apo. small, margins prominent. R.	12. A. Heppii Koerb.

53. **LECANIA** Massal.—Sometimes squamulose, imbricate or lobed at the circumference and corticate above, or variously crustaceous. Apothecia reddish-brown or blackish, marginate when young, the margin often disappearing; spores 8–16, colourless, more or less elongate and rather narrow, 1–3-septate.

In many species the thalline margin disappears at an early stage, but the presence of algæ below the hypothecium indicates their position in Lecanoraceæ.

Squamulose. Spermogones with pleurogenous spermatia	§ i. PLACOLECANIA.
Crustaceous. Spermogones with acrogenous spermatia	§ ii. EULECANIA.

§ i. PLACOLECANIA Stein.—Thallus squamulose, effigurate or scattered. On rocks, or on soil.

Orbicular, white, areolate in centre, lobate-effigurate. F.	1. L. candicans A. Zahlbr.
Imbricate brown, cartilaginous squamules. R.	2. L. holophæa A. L. Sm.
Minute scattered or massed white granules. R.	3. L. leucospeirea A. L. Sm.

§ ii. EULECANIA Stizenb.—Thallus crustaceous. Apothecia frequently becoming immarginate. Most of the rock species are maritime.

*Spores mostly 1-septate. On rocks.

†Thallus determinate or subdeterminate.

Dark-leaden-grey or blackish.
Apo. brown; sp. 18–23 × 6–9 μ. R. 4. L. Ralfsii A. L. Sm.
Apo. dark-brown; sp. 12–14 × 4–5 μ. R. .... 5. L. actæa B. de Lesd.
Brown or grey. Apo. dark.
In small patches, areolate. R. ..... 6. L. spodophæiza A. L. Sm.
Mostly of crowded angular papillæ. R. .... 7. L. aipospila Th. Fr.

††Thallus effuse, areolate or granulose.
Light-coloured. Mostly maritime.
Whitish, thin. Limestone or mortar. R. .... 8. L. albariella A. L. Sm.
Whitish or dull-yellow, thicker. Apo. reddish-brown. C. .... 9. L. prosechoides Oliv.
Brown, thin. Apo. margin light-grey, crenulate. R. .... 10. L. spodomela A. L. Sm.
Grey, thick. Apo. crowded, margin entire or subcrenulate. R. ... 11. L. atrynoides Knowles.
Whitish, thin. Apo. darkish with white farinose margin. R. ... 12. L. cæsia A. L. Sm.
Darker, crowded. On rocks (*L. erysibe* rarely on wood).
Blackish, areolate, thin. Apo. small, blackish. R. .... 13. L. prosechoidiza A. L. Sm.
Greenish-olive, areolate, thin. Apo. brown. C. .... 14. L. erysibe Mudd.
Th. whiter and granular .... Var. sincerior B. de Lesd.
Dull-brown, furfuraceous. Apo. red- or yellow-brown. R. .... 15. L. Hutchinsia A. L. Sm.
Greenish, leprose. Apo. yellowish. R. 16. L. umbraticula A. L. Sm.

*Spores 3-septate.
Variously coloured. On walls or trees, etc.
Grey, unequal. Apo. dark, bluish-white-pruinose. Walls. R. ... 17. L. Nylanderiana Massal.
Greyish-white, furfuraceous. Apo. small, dark. Trees (maple, poplar). F. .... 18. L. syringea Th. Fr.
Grey, effuse, thin. Sp. curved 12–18 × 4–6 μ. Poplar. R. 19. L. dubitans A. L. Sm. (*Lecanora dimera* Nyl.)
Grey or brown, granular. Sp. slightly curved, 30–34 × 4–6 μ. Alpine mosses. R. .... 20. L. curvescens A. L. Sm.

54. **ICMADOPHILA** Massal. Crustaceous, not corticated. Apothecia sessile or subsessile, with a thalline margin which finally disappears; hypothecium colourless, with gonidia partly below; paraphyses slender, simple, free; spores fusiform, 2–4-celled, colourless.

The one British species is frequently classified as *Bæomyces æruginosus*. It differs from *Bæomyces* in the structure of the apothecium.

Granular, greenish or whitish. Apothecia moderate in size or large, rose-coloured. Soil. C. .... I. ericetorum.

55. **HÆMATOMMA** Massal.—Crustaceous, corticate or non-corticate on the upper surface. Apothecia sessile or sometimes immersed, generally brightly coloured (red or brown); paraphyses discrete; spores 8, narrow or acicular, straight or bent, 3-many-septate, colourless.

The saxicolous species are common in upland districts, the brightly coloured apothecia conspicuous on the generally light-coloured wide-spreading thallus. *H. elatinum* grows on holly in Killarney; it occurs frequently in Scandinavia.

On rocks and boulders.
  Warted, not leprose. Apo. dark-red .... 1. H. ventosum Massal.
  Often leprose. Apo. generally crimson......... 2. H. coccineum Koerb.
On holly.
  Thallus thin, furfuraceous. Apo. light-brownish-red .... 3. H. elatinum Koerb.

FAMILY XIV. PERTUSARIACEÆ.

Thallus crustaceous, effuse or determinate, attached by hyphæ to the substratum, corticate or non-corticate above. Algal cells Protococcaceæ. Apothecia one or several immersed in thalline protuberances (verrucæ or warts), generally with a tumid converging margin, or opening to a discoid form; paraphyses slender, branched and intricate; spores 1-8, colourless, (rarely blackish), generally very large, oblong-ellipsoid, simple or 1-septate. Spermogones with simple or sparingly branched sterigmata and acrogenous long spermatia.

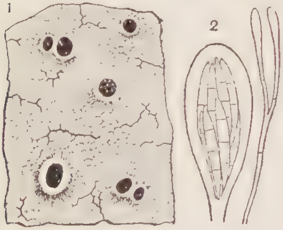


FIG. 36.—*Hæmatomma coccineum* Koerb. 1. Plant on rock. 2. Ascus with spores and paraphyses × 400.

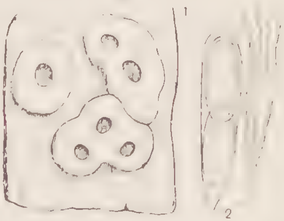


FIG. 37.—*Pertusaria pertusa* Dalla Torre and Sarnth. 1 Portion of plant on bark × 5. 2. Ascus with spores and paraphyses × ca. 65.

Allied to *Lecanora*, section *Ochrolechia*, through the characters of spores and paraphyses.

  Spores simple.............................. 56. **Pertusaria,**
  Spores 1-septate .... 57. **Varicellaria.**

56. **PERTUSARIA** DC.—Thallus continuous or cracked, varying in thickness, corticate or non-corticate above, generally superficial on the substratum, soredia often present. Apothecia generally immersed in the thalline verrucæ, the disc visible as a small point sometimes opening wider;

hypothecium colourless; spores 1–2 or 4–8, mostly colourless, simple, with a thick epispore, usually very large up to 310 μ long, and 100 μ thick.

In *Pertusaria* the thallus is often fairly thick and the fertile verrucæ very prominent. The soredia when present appear generally in the form of "soralia," definite bodies, mostly round in outline, resembling abortive apothecia. There is great variation in the size of the spores depending on the number formed in each ascus; the predominating number is that given in the diagnosis. Unless otherwise stated the thallus is grey.

*Spores one in the ascus.	
†Thallus not sorediate.	
On mosses.	
K + y then red. Of elongate papillæ. Apo. immersed. Alpine. R.	1. P. dactylina Nyl.
Thickish, warted. Apo. immersed then open. S.W. Ireland. R.	2. P. Hutchinsiæ Leight.
On rocks.	
K + y then red. Thickish, densely papillose. Apo. discoid. Mountains. R. ...	3. P. monogona Nyl.
††Thallus more or less sorediate.	
On mosses.	
Spreading, thin. Apo. discoid. R.	4. P. bryontha Nyl. †
On trees.	
Thin; verrucæ small, sometimes subleprose. R	5. P. opthalmiza Nyl.
C + red. Thickish, granulate-cracked; verrucæ sometimes sorediate. F.	6. P. velata Nyl.
Verrucæ large, densely sorediate	f. aspergilla Cromb.
Thickish, margin zonate; soralia large. Mostly sterile. C. ...	7. P. globulifera Nyl.
K(C) + rose. Thin, bitter tasted; soralia small, crowded. C.	8. P. faginea Leight. (*P. amara* Nyl.)
Med. K + y then red. Thin, not bitter; soralia small scattered. C.	9. P. multipuncta Nyl.
K + y then red. Otherwise similar to preceding. R.	10. P. reducta Stirt.
On rocks.	
C + red. Rather thin, dotted with soralia. F.	11. P. lactea Nyl.
Wrinkled, warted and papillate, sometimes sorediate. R.	12. P. melanochlora Nyl.
**Spores usually two in the ascus.	
†Thallus without soredia.	
§Spores colourless.	

On trees.

Kf + y. Thin, whitish, verrucæ scattered. Apo. lacerate. R. 13. P. pustulata Nyl.

K + y. Thickish, wrinkled, verrucæ large, crowded. C. 14. P. pertusa Dal. Tor. & Sarnth. (*P. communis* DC.)

On rocks.

K + y. Cracked-areolate, papillate. Mostly sterile. Epi. K + violet. R. .... 15. P. areolata Nyl.

K + y then red. Plane with smooth crowded verrucæ, whitish. F. .... 16. P. ceuthocarpa Turn. & Borr.

K + y then red. Thickish areolate whitish. Apo. immersed. S. .... 17. P. concreta Nyl.

Becoming minutely papillate. F. . ... f. Westringii Nyl.

§§Spores olivaceous or blackish, K + violet. On rocks.

K + y then red. Thickish, smooth. R. .... 18. P. lactescens Mudd.

K + y then red. Scabrid with short papillæ. R. .... 19. P. urceolaria Nyl.

††Thallus sorediate. Spores colourless. On trees.

K + y then red. Thin, areolate, subfarinose or isidiose. R. .. 20. P. coccodes Nyl.

K + y then ? red. Of crowded small granules or papillæ. C. .... 21. P. dealbata Cromb.

Densely coralloid-papillate f. corallina Cromb.

***Spores usually four in the ascus.

†Thallus without soredia, white or whitish.

On mosses.

K + y then red. Thin, verrucæ small, crowded. R. .... 22. P. glomerata Schær.

On trees, heath stems, etc.

Thin, subimmersed; verrucæ scattered. C. .... 23. P. leioplaca Schær.

Thin, superficial. Apo. disc yellowish. R. .... 24. P. xanthostoma Fr.

††Thallus sorediate, greenish-yellow.

On trees.

Thickish, unequal; verrucæ sorediate. R. .... 25. P. lutescens Lamy.

****Spores usually eight in the ascus.

†Thallus without soredia.

On mosses.

Of slender coralloid papillæ. Apo. in papillæ. R. .... 26. P. oculata Th. Fr.

On trees.
  Formed under the bark. Apo. erumpent. R. .... 27. P. carneopallida Nyl.
  Thin, verrucæ scattered. Apo. margin crenate; epi. K + violet. C. .... 28. P. Wulfenii DC.
On rocks. Epithecium K + violet.
  Thin, continuous or cracked. Apo. with open disc. R. ..... 29. P. inquinata Th. Fr.

††Thallus sorediate. Epithecium K + violet.
On rocks.
  Greenish-yellow, thickish. Apo. sub-discoid. F. .... 30. P. sulphurea Schær.

57. **VARICELLARIA** Nyl.—Thinly crustaceous, corticate. Apothecia immersed in convex verrucæ; spores large, ellipsoid, 1-septate, colourless. Spermogones unknown.

The thallus of the British species is whitish, smooth, though occasionally leprose. The solitary spore is up to 225–350 μ long, 95–115 μ thick. It is an alpine soil lichen.

Apo. disc pale-reddish.................. V. microsticta Nyl.

FAMILY XV.—THELOTREMACEÆ.

Thallus crustaceous, thin or thickish, mostly non-corticate. Algal cells *Trentepohlia* or Protococcaceæ. Apothecia at first immersed and closed, then more or less open, with a proper margin generally well developed and usually surrounded by an overarching thalline margin; paraphyses simple or branched; spores 1–8, elongate-septate or muriform, rather large, colourless or dark-coloured. Spermogones with acrogenous short or long and curved spermatia.

The immersed apothecia recall those of Pertusariaceæ, but they are solitary with a more pronounced proper margin. In *Phlyctis*, however, that margin is somewhat poorly represented, while in *Conotrema* it is the thalline margin that tends to disappear.

Algal cells *Trentepohlia*.
  Spores septate or muriform, large .... 58. **Thelotrema.**
Algal cells *Protococcacea*.
  Spores elongate, narrow, multi-septate .... 59. **Conotrema.**
  Spores muriform, colourless .... 60. **Phlyctis.**
  Spores muriform, dark-coloured .... 61. **Diploschistes.** (*Urceolaria.*)

58. **THELOTREMA** Ach.—Crustaceous, superficial or partly developed beneath the bark, non-corticate or with an amorphous cortex. Algal cells *Trentepohlia*. Apothecia at first immersed in small verrucæ, the disc half-concealed or opening out, the inner proper margin persistent, the outer margin prominent, overarching the disc; paraphyses slender, massed; spores 1–8, large, oblong or fusiform, septate or irregularly muriform colourless.

A tropical or warm-temperate genus characterised by the crater-like apothecia and by the septate or muriform spores:—

Spores elongate, 8–12-septate. Bark. C.	1. Th. lepadinum Ach.
Spores muriform, large. Bark or stone. R.	2. Th. subtile Tuckerm.

59. **CONOTREMA** Tuckerm.—Crustaceous, membranaceous, uniform. Apothecia immersed, becoming superficial, urceolate, the proper margin black, the thalline margin thin, soon disappearing; hypothecium blackish; spores elongate, cylindrical, slender, colourless, multiseptate (up to 30–40-septate).

A small genus, with the whitish thallus developed as a thin film on the bark. Both species are rare: No. 1, alpine, No. 2, from Killarney.

Apo. small; spores up to 160 μ long	1. C. urceolatum Tuck.
Apo. rather large; spores up to 140 μ long	2. C. homalotropum A. L. Sm.

60. **PHLYCTIS** Wallr.—Crustaceous, continuous or cracked, or pulverulent, developed above or beneath the bark, light-coloured. Apothecia immersed, then scarcely emerging, the proper margin poorly developed, the outer thalline margin irregularly dehiscent or indistinct; paraphyses slender, mostly unbranched; spores 1–8, elongate or ellipsoid, muriform, colourless, with a thin epispore.

The thin effuse thallus, the immersed apothecia and muriform spores show the affinity with Thelotremaceæ. In appearance the two species are not unlike *Pertusariæ*. Both are corticolous.

Spores apiculate at each end, 45–70 $\mu \times$ 14–27 μ. C.	1. Phl. agelæa Koerb.
Spores not apiculate, 100–140 $\mu \times$ 27–50 μ. F.	2. Phl. argena Koerb.

61. **DIPLOSCHISTES** Norm.—Crustaceous, generally areolate, sometimes with an amorphous cortex. Apothecia immersed-urceolate, with a well-developed proper dark margin, and an outer thalline margin; hypothecium dark-coloured; paraphyses slender; spores 4–8, muriform, becoming dark-brown.

A small genus, more generally known as *Urceolaria*, not unlike *Thelotrema* in the form of the apothecia. *D. scruposus* is a common rock, tree or wall lichen. In the British species there is a red reaction with CaCl.

*Apo. up to 2 mm. across; sp. up to $40 \times 20\,\mu$.	
Thick, uneven, light- or dark-grey. Rocks. C.	1. D. scruposus Norm.
Thin, pulverulent grey. Mosses. F.	2. D. bryophilus Zahlbr.
Thick, wrinkled, white. Rocks. R.	3. D. gypsaceus Zahlbr.
**Apothecia small; sp. 35×16–$23\,\mu$.	
Thickish, smooth, areolate, light- or dark-grey (not recorded)	4. D. actinostoma Zahlbr.
Greyish-leadened-coloured. Rocks. R.	Var. cæsioplumbea A. L. Sm.

FAMILY XVA. CHRYSOTHRICACEÆ.

Thallus felted, spongy, of branched loosely interwoven hyphæ, not corticate. Algal cells Protococcaceæ or *Trentepohlia*, generally in groups lodged among the hyphæ (partly homoiomerous). Apothecia without a thalline margin, but with a double proper margin; spores colourless, simple or septate. Spermogones with simple sterigmata and small spermatia.

The Family is characterized by the byssoid structure of the thallus.

Thallus byssoid, with algal cells Protococcaceæ …… 62. **Crocynia.**

62. **CROCYNIA** Massal. (*Leproloma* Nyl.).—Thallus of felted intricate hyphæ, speading, non-corticate. Apothecia immersed or sessile, without a thalline margin, the disc red or blackish; paraphyses conglutinate, thickish, not branched; spores 6–8, simple or 1–3-septate, colourless.

The thallus of the single British species is orbicular, granular-pulverulent at the centre. It is sterile. A number of species, also sterile, have been recorded from France.

White or yellowish-white. Mosses on rocks. C. … 1. C. lanuginosa Hue.

Family XVI. GYROPHORACEÆ.

Thallus foliose, monophyllous or polyphyllous, corticate on both surfaces, attached by a central hold-fast or by rhizinæ. Algal cells Protococcaceæ. Apothecia sessile or almost stalked, with proper margin only (lecideine); the disc plane or furrowed (gyrose), black; spores 1 or 8, colourless or dark-brown, simple or muriform. Spermogones with septate sterigmata and pleurogenous spermatia (in British genera).

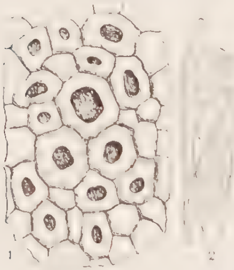


Fig. 38.—*Diploschistes scruposus* Norm. 1. Plant on stone × 5. 2. Ascus and paraphysis × 180.

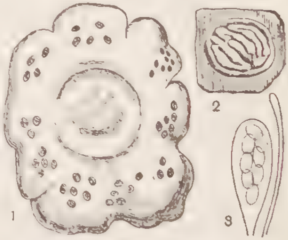


Fig. 39.—*Gyrophora proboscidea* Ach. 1. Plant from rock, slightly reduced. 2. Portion of plant and apothecium × 7. 3. Ascus with spores and paraphysis × 400.

This Family is classified with Cladoniaceæ and Lecideaceæ on account of the lecideine fruit (Order Lecideales).

Apothecia mostly gyrose; spores simple, colourless …… 63. **Gyrophora.**
Apothecia plane; spores muriform, dark-brown………… 64. **Umbilicaria.**

63. **GYROPHORA** Ach.—Foliose, with plectenchymatous cortex on both surfaces, attached mainly by a subcentral hold fast, naked or rhizinose below. Apothecial disc plane or more or less concentrically furrowed, with alternate fertile and sterile tissue; hypothecium dark-coloured; paraphyses subdiscrete; asci ellipsoid-cylindrical or broadly ellipsoid; spores 8, simple (rarely septate), rather small, ellipsoid, colourless or becoming brownish.

The British species of *Gyrophora*, with one exception, have gyrose apothecia; they are saxicolous plants, and are mainly found in upland, mountainous or northern regions; they vary in colour from light cinerous-grey to brownish-black.

Apothecial discs plane .... § i. AGYROPHORA.
Apothecial discs gyrose .... §§ ii. EUGYROPHORA.

§ i. AGYROPHORA A. Zahlbr.—Discs plane. Thallus monophyllous or polyphyllous.
Finely cracked- or wrinkled-areolate. R. .... 1. G. leiocarpa Steudel.

§ ii. EUGYROPHORA A. Zahlbr.—Discs gyrose. Thallus various.
*Rhizinæ or fibrils few or wanting.
†Thallus mainly monophyllous.
Minutely papillate-areolate; sometimes scantily rhizinose. R. .... 2. G. grisea Turn. & Borr.
Wrinkled-reticulate; beneath smooth. F. .... 3. G. proboscidea Ach.
Crowdedly granulate-wrinkled; beneath minutely papillose. R. .... 4. G. artica Ach.
Thin, tough, pustulate-wrinkled; beneath finely granulate. R. 5. G. hyperborea Ach.
Flocculose or minutely isidiose; beneath pitted-lacunose. F. 6. G. flocculosa Turn. & Borr.
††Thallus multilobate or polyphyllous.
Smooth, shining, brown; beneath smooth, blackish. C. .... 7. G. polyphylla Hook.
**Rhizinæ or fibrils at margins and beneath.
Margins densely fibrillose; rhizinæ scanty. F. .... 8. G. cylindrica Ach.
***Rhizinæ on under surface only.
Sometimes scantily rhizinose ... 2. G. grisea Turn. & Borr.
Erose at margins; minutely rhizinose or scaly. R. .... 9. G. erosa Ach.
Sparingly erose; beneath lacunose-trabeculate. C. .... 10. G. torrefacta Cromb.
Rhizinæ dense, black, branched at tips. C. .... 11. G. polyrrhiza Koerb.
Rhizinæ grey or brown, not branched at tips. R. 12. G. cirrosa Wain. (*G. spodochroa* Ach.)

64. **UMBILICARIA** Hoffm.—Rather large, dark-coloured, leathery, with a single central or subcentral hold-fast, without rhizinæ. Apothecia sessile, discoid, the disc mostly plane; hypothecium dark-coloured; paraphyses discrete; spores 1–2, ellipsoid, dark-coloured, rather large, muriform, with a thin epispore.

The single British species grows on rocks in northern or upland regions.

The upper surface frequently bears long branching isidia, and is covered by oblong-ovoid pustules with corresponding depressions or "foveolæ" below. The cortex of both surfaces is plectenchymatous. It is abundant in arctic regions and, along with species of *Gyrophora*, is known as "rock-tripe."

Thallus greyish, black, monophyllous .... U. pustulata Hoffm.

FAMILY XVII. CLADONIACEÆ.

Thallus usually of twofold character:—primary or basal, crustaceous or squamulose, often evanescent attached to the substratum by a hypothallus, by rhizinæ or occasionally by a branching rhizoid, corticate or non-corticate; secondary thallus or podetium upright, varying from a short apothecial stalk to a long simple or branched structure, usually tubular, corticate or non-corticate, tapering to a point or opening above into a trumpet-shaped scyphus. Algal cells Protococcaceæ. Apothecia sessile on the tips of the podetia or on the margins of the scyphus, brown or red in colour, immarginate; paraphyses generally unbranched; spores 6-8, simple or variously septate, colourless. Spermogones with acrogenous spermatia.

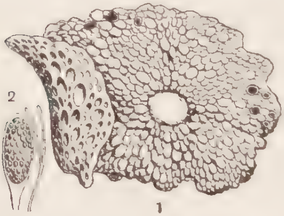


FIG. 40.—*Umbilicaria pustulata* Hoffm.
1. Plant from rock, reduced ½. 2. Ascus and spore with paraphysis × 300.

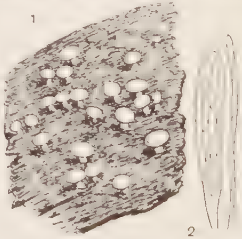


FIG. 41.—*Bæomyces roseus* Pers.
1. Plant on soil. 2. Ascus with spores and paraphysis × 300.

The upright thallus in *Cladonia* is endogenous in origin and has been on that account regarded as an apothecial stalk or elongation of the conceptacle. It has become, with few exceptions, transformed to a vegetative thallus. The podetia of *Pilophorous* and *Stereocaulon* are exogenous in origin.

Podetia very short, usually simple.
  Podetia glabrous.
    Thallus granular. Spores simple or 1-sept. (Brit. species) .... 65. **Bæomyces.**
    Thallus a gelatinized crust. Spores up to 100-septate.. 66. **Gomphillus**
  Podetia granular.
    Thallus granular. Spores simple .... 67. **Pilophorus.**
Podetia usually well developed, often branched.
  Podetia with a solid stalk. Spores 4-pluriseptate ...... 68. **Stereocaulon.**
  Podetia with a hollow stalk. Spores simple .... 69. **Cladonia.**

65. **BÆOMYCES** Pers.—Horizontal or primary thallus crustaceous, granular-pulverulent or squamulose. Podetia endogenous in origin, rising from the thalline granules, very short and with or without gonidia. Apothecia terminal, immarginate, dark- or light-coloured; hypothecium pale; spores usually 8, ellipsoid or fusiform, narrow, simple or 1-septate, colourless.

The British species grow on soil in moorland or upland regions, and the light-greenish thallus often spreads extensively. *B. æruginosus* is classified under *Icmadophila* (Lecanoraceæ).

Granular. Apo. red-brown. C.	1. **B. rufus DC.**
Minutely squamulose. Pod. scarce	Var subsquamulosa Nyl.
Granular. Apo. rose-coloured. C.	2. **B. roseus Pers.**
Membranaceous or squamulose. Apo. light-brownish. R.	3. **B. placophyllus Ach.**

66. **GOMPHILLUS** Nyl.—Thallus effuse, of thick-walled agglutinate hyphæ and sparsely scattered gonidia, forming a thin gelatinized continuous crust. Apothecia one or several at the tip of a very short stalk or podetium rising from the horizontal thallus, dark-coloured, of a horn-like consistency; spores 8, filiform, pluriseptate.

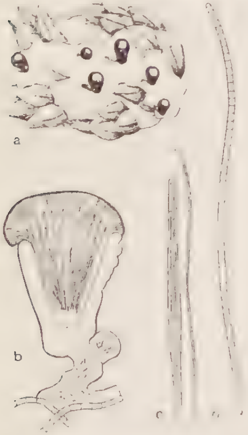


FIG. 42.—*Gomphillus calycioides* Nyl.
a. Plant on mosses. b. Vertical section of apothecium × 30. c. Ascus with spores and paraphysis × 100. d. Spore × 250.

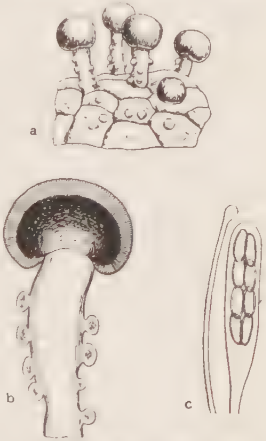


FIG. 43.—*Pilophorus cereolus* Stiz.
a. Plant on rock × 5. b Vertical section of podetium and apothecium × ca. 17. c. Ascus with spores and paraphysis × 200.

A monotypic genus most nearly allied to *Bæomyces*. It grows over mosses on the ground, trees or boulders. The long thread-like spores are about 100-septate.

Greyish or greyish-green. Apo. almost black. R.	G. calicioides Nyl.

67. **PILOPHORUS** Th. Fr.—Primary thallus crustaceous, granular or minutely squamulose, non-corticated, sprinkled with flat granular olivaceous cephalodia. Podetia developed from the upward growth of the granules (not endogenous), rigid, cylindrical, simple or sparingly branched, beset with granules, non-corticated, tubular or solid, with a central strand of compact parallel hyphæ. Apothecia terminal on the podetia, single or in groups, subglobose, immarginate: hypothecium thick, black; paraphyses thickish, dark at the apices; asci clavate, thickened at the apices; spores 8, elongate-ellipsoid, simple.

Differs from *Stereocaulon* in the persistent thallus and dark apothecia. There is only one British species, found on moist shady rocks, in hilly regions. The warted flattened cephalodia contain *Stigonema* algæ.

Thin, greyish-white. Pod. short, erect, simple. F. .... P. cereolus Stiz.

68. **STEREOCAULON** Schreb.—Primary thallus granular or minutely squamulose, usually soon evanescent. Podetia erect or decumbent developed from the upward growth of the primary thallus (not endogenous), much branched, solid in the centre, beset with small warts or squamules which are more or less corticate. Cephalodia, as warts or tubercles, usually present on the podetia, containing *Stigonema* or *Nostoc*. Apothecia terminal or lateral, usually dark-brown, immarginate (rarely with a thalline margin); hypothecium colourless; paraphyses slender, discrete; asci cylindrical; spores 6–8, elongate, 4-pluriseptate, colourless.

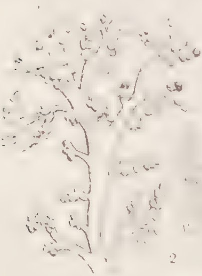


FIG. 44.—*Stereocaulon coralloides* Fr.
1. Frond of plant. 2. Ascus with spores and paraphysis × 250.

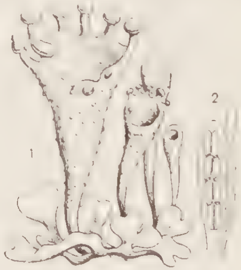


FIG. 45.—*Cladonia coccifera* Willd.
1. Plant with squamules and podetia (with scyphi). 2. Ascus with spores and paraphysis × 450.

The species with a persistent thallus grow usually on turfy soil, either on the ground or on walls; the others grow mostly on rocks and boulders. They are plants of hilly or upland regions.

Cephalodia dark in colour, containing *Stigonema*.
  Primary thallus persistent.
    Subsquamulose or coarsely granular. Pod. short. C. .... 1. S. condensatum Hoffm.
    Granular-coralloid. Pod. longer. F. ...... 2. S. pileatum Ach.

Pulverulent. Pod. slender, short, powdery. C.	3. S. nanum Ach.
Primary, thallus evanescent. Squamules on podetia.	
Sq. branching-coralloid. C.	4. S. coralloides Fr.
Sq. becoming sorediate. R.	5. S. Delisei Bory.
Sq. turgid, crowded, shortly branched. C.	6. S. evolutum Græwe.
Sq. palmate. R.	7. S. paschale Fr.
Sq. peltate. F.	8. S. denudatum Floerke.
Pod. in crowded cushions	Var. pulvinatum Th. Fr.
Cephalodia bluish-green, containing *Nostoc*.	
Pod. tomentose; sq. palmate. F.	9. S. tomentosum Fr.
Pod. slightly tomentose; sq. turgid. R.	10. S. alpinum Laur.

69. **CLADONIA** Hill.—Primary thallus evanescent, crustaceous or squamulose; secondary thallus or podetium upright, simple or branched, ending in a point or widening to form a shallow cup or scyphus, more or less corticate, smooth, granular, pulverulent or beset with squamules, tubular and sometimes perforate at the axils or at the base of the scyphus. Apothecia terminal, at first somewhat plane and marginate, becoming convex, pale- or dark-brown or red; spores 8, simple, colourless.

Cladoniæ are nearly all earth lichens, and are most frequently to be found on moorland or peaty soil.

Primary thallus evanescent or persistent.		
Soon evanescent. Pod. mostly ascyphous	Subgen.	i. CLADINA.
Crustaceous, persistent. Pod. ascyphous	,,	ii. PYCNOTHELIA.
Squamulose, mostly persistent. Pod. scyphous or ascyphous	,,	iii. CENOMYCE.

Subgen. i. CLADINA Leight.—Basal thallus granular, scanty, soon disappearing; podetia perishing at the base, with continued apical growth.

There is no visible thallus in the *Cladinæ*, and no podetial squamules occur in any of the species. They are ascyphous with the exception of *Cladonia amaurocræa* and *C. destricta* (occasionally). *C. rangiferina* is the well-known "reindeer moss."

*Ascyphous, greenish-grey, slender, much branched.	
K+y. Tomentose, cylindrical; branchlets bent to one side. Heather. R.	1. C. rangiferina Web.
K−. Less tomentose, smaller; branchlets more spreading. Heather. C.	2. C. sylvatica Hoffm.
Turgid and denticulate at apex	Var. portentosa Wain.
Branching cymose, short, thyrsoid. Moist uplands. R.	3. C. alpestris Bausch.
**Ascyphous, yellowish, tubular, less branched, stout.	
Broadly tubular, subulate. Damp places. C.	4. C. uncialis Web.
Short and narrow, f. *bolacina* Nyl.; long and stout, f. *elatior* Fr.	

***Scyphi occasional.

Upright, yellowish, as in N. 4. Ground. R. .... **5. C. amaurocrea Schær.**

Mostly decumbent, greenish - grey. Moors. R. .... **6. C. destricta Wain.**

Subgen. ii. Pycnothelia Leight.—Primary thallus crustaceous, persistent; podetia very short, like papillæ or cones.

The single British species grows on the ground, on exposed moorlands, etc.

Thallus effuse, granular whitish or greyish....... 7. C. papillaria Hoffm.

With stouter branched podetia.................... Var. molariformis Nyl.

With reduced podetia................................ Var. apoda Nyl.

Subgenus ii. Cenomyce Th. Fr.—Primary thallus squamulose or foliaceous, usually persistent; podetia mostly well-developed, scyphous or ascyphous. Apothecia pale- or dark-brown, or red.

The *Cladonia* of the subgenus *Cenomyce* are found mostly on undisturbed mossy earth or on sandy soil, on the ground or on rocks. In general those species with a well-developed primary thallus grow on dry exposed places; those in which the basal squamules are reduced or evanescent grow in more protected places, among heaths, etc. A few species grow by preference on old stumps or on trunks of trees, as, for instance, *C. parasitica* and *C. macilenta*. They sometimes spread widely and are often intermingled. In certain conditions the superficial granules or cortical areolæ of the podetia grow out into squamules somewhat similar to those of the base, and thus many species have a squamulose variety or form.

In the diagnoses "large" squamules are from 1 to 3 cm. in length, with lesser width; "medium"-sized are about 1 cm. or less; and "small" about 2 to 5 mm. The podetia when "short" are a few mm. in length; medium-sized 2 to 3 cm.; and elongate or tall more than 3 cm.

Series A.—**Phæocarpeæ.**—Apothecia brown-coloured.

1. Podetia without perforations at tips or axils (*closed*), mostly scyphiferous.

*Podetia not, or only partly, corticate.

†Basal squamules large, sometimes almost foliose.

Pod. rather short, simple, often several on one frond. C. .... **8. C. foliacea Willd.**

Sq. crowded and ascending .... **Var. firma Wain.**

Sq. very large and spreading............ **Var. endivæfolia Schær.**

Pod. short, branched, coralloid - like when fertile. R. .... **9. C. strepsilis Wain.**

††Basal squamules mod. or small, thickish.

Sq. small, pod. coralloid. R. .... **9. C. strepsilis Wain.**

Pod. mod., med. coarsely granular, with wide scy. C. .... **10. C. pyxidata Hoffm.**

Sq. dark - coloured; pod. short, verrucose. F. .... **Var. pocillum Fr.**

Pod. longer, granular below, furfuraceous above. C. Var. chlorophæa Floerke.

Becoming densely squamulose, f. *lepidophora* Floerke.

Pod. mod., finely pulverulent; scy. narrow, often proliferous. C. ...... 11. C. fimbriata Fr.
Scy. narrow, not proliferous. C. ..... Var. simplex Wain.
Pod. long, slender, whitish; scy. narrow or absent. R. .... Subsp. fibula Nyl.
Pod. branched, straggling, f. *nemoxyna* A. L. Sm.
Scy. radiate-proliferous from margins. C. Var. radiata Cromb.
Scy. absent; pod. branched. C. ...... Var. subcornuta Nyl.
†††Basal squamules minute and scattered.
Pod. ascyphous minute, smooth, sometimes bifid. R. .... 12. C. leptophylla Floerke.
**Podetia sometimes imperfectly corticate.
Basal squamules medium sized.
Pod. short, partly corticate below, pulverulent above; scy. narrow or absent. Apo. yellowish-brown. S. 13. C. ochrochlora Floerke.
Pod. short, with contiguous warts, or granulate; scy. narrow, irregular. C. 14. C. pityrea Fr.
Densely squamulose f. *hololepis* Cromb.
Pod. somewhat similar, but long, pointed, ascyphous. R. .... 15. C. acuminata Norrl.
***Podetia partly or entirely corticate; often ascyphous.
†Basal squamules rather large, (dense, ascending in *C. cervicornis*).
Pod. mod. unequally corticate, black in interstices; scy. proliferous. F. ... 16. C. degenerans Spreng.
Beset with squamules..................... Var. phyllophora Syd.
Pod. almost colourless; scy. repeatedly proliferous "in tiers." R. .... Subsp. trachyna Nyl.
Pod. small, crowded, pale, cortex continuous or in areolæ (not Brit.)...... 17. C. lepidota Nyl.
Scy. irregular, large, spreading, f. *hypophylla* Cromb.
Pod. short, proliferous from centre or margin of scy. C. .... 18. C. cervicornis Schær.
††Basal squamules small, scanty, scattered.
Pod. proliferous from centre of scy. in tiers. S. .... 19. C. verticillata Floerke.
Pod. smooth, corticate, long, slender; scy. narrow. C. .... 20. C. gracilis Willd.
Pod. and scy. spinulose, f. *spinulifera* Cromb.
Stouter; scy. usually present .... Var. hybrida Schær.
Pod. squamulose .... Var. aspera Floerke.
Pod. partly corticate, pulverulent upwards, long, pointed. S. .... 21. C. cornuta Fr.
****Podetia fissured or latticed.
Basal sq. large. R. .... 22. C. macrophylla Stenh.
Basal sq. small. S. .... 23. C. cariosa Spreng.
Basal sq. minute, round; pod. scanty, splitting. R. .... 12. C. leptophylla Floerke.

2. Podetia with perforations at axils, tips, or in scyphi (*pervious*).

*Pod. corticate, smooth; scy. none or small.
Basal sq. rather large.
Pod. turgid, wide and dentate at tips. R. 24. C. turgida Hoffm.
Pod. rather turgid, perforations crispate. R. .... 25. C. crispata Flot.
Basal sq. small, soon evanescent. Pod. rather long, branched.
K –. Pod. in tufts, slender, tips furcate. C. .... 26. C. furcata Schrad.
Spinous, curved .... Var. spinosa Leight.
Dark-brown, stoutish, entangled, with turgid areolæ............ Var. palamæa Nyl.
Scabrid, with minute sq., recurved or upright............ Var. recurva Hoffm.
K + y. Pod. in congested tufts, slender, furcate. C. 27. C. rangiformis Hoffm. (*C. pungens* Floerke).
Sprinkled with squamules .... Var. foliosa Wain.
Stoutish, with sq.; base turgid-areolate Var. muricata Arn.
**Podetia mostly decorticate, usually with scyphi, generally pervious.
Basal sq. small or evanescent.
Pod. pulverulent or partly corticate. S. 28. C. cenotea Schær.
Pod. long; scy. rare .... Var. glauca Leight.
Pod. almost decorticate, granular or squamulose. K –. C. .... 29. C. squamosa Hoffm.
Sq, of base and pod. crenate .... Subsp. denticollis Hoffm.
Pod. almost decorticate, granular or squamulose K + y. C. .... 30. C. subsquamosa Nyl.
Basal sq. small, persistent (sorediose in n. 32).
Pod. very short, smooth. C. .... 31. C. cæspiticia Floerke.
Pod, short, furfuraceous. On wood. R. 32. C. parasitica Hoffm. (*C. delicata* Floerke).

Series B.—**Cocciferæ.** Apothecia red-coloured.

*Podetia scyphiferous.
Basal sq. large.
Sq. yellow beneath. Pod. minute. R. .. 33. C. luteoalba Wils. & Wheld.
Sq. white beneath, pulverulent. Pod. large, scy. proliferous. F. .... 34. C. digitata Hoffm.
Basal sq. moderate in size.
Pod. long, turgid, yellow-pulverulent. F. 35. C. deformis Hoffm.
Pod. coarsely granular; scy. large. C. .. 36. C. coccifera Willd.
Becoming sorediose upwards .... Subsp. pleurota Cromb.
Pod. cylindrical, densely sq. Apo. large. F. .... 37. C. bellidiflora Schær.
Pod. without sq. .... Var. Hookeri Nyl.
Pod. finely pulverulent; scy. mostly coronate. C. .... 38. C. flabelliformis Wain.

**Podetia ascyphous.
  K + y. Pod. rather slender, white-pulverulent. C. .... 39. C. macilenta Hoffm.
    Clavate and turgid, sometimes sq., f. *clavata* Cromb.; slender and short. f. *scoleccina* Nyl.
      Pod. densely squamulose.................. Var. scabrosa Cromb.
      Basal sq. pulverulent, crowded .... Var. ostreata Nyl.
  K –. Pod. rather slender, white-pulverulent. C. .... 40. C. bacillaris Nyl.
    Turgid, squamulose, f. *pityropoda* Nyl.
      Sparsely sq., digitately branched above Var. subcoronata Nyl.
  K –. Pod. short, slender, rough, with corticate areolæ. C. .... 41. C. Floerkeana Fr.
    Becoming squamulose .... Var. carcata Wain.

FAMILY XVIII. CŒNOGONIACEÆ.

Thallus filamentous and byssoid, in small patches or widely spreading. Algal cells *Trentepohlia* or *Cladophora*. Apothecia with a proper margin; spores 8, colourless, simple or 1-septate.

With *Trentepohlia* gonidia.................................... 70. **Cœnogonium.**
With *Cladophora* gonidia .... 71. **Racodium.**

70. **CŒNOGONIUM** Ehrenb.—Thallus of loose branching filaments, mostly light-coloured. Algal cells *Trentepohlia* forming a central strand closely invested by irregularly branching hyphæ. Apothecia apical or lateral, discoid, not carbonaceous; paraphyses discrete; spores fusiform or ellipsoid, simple or 1-septate.

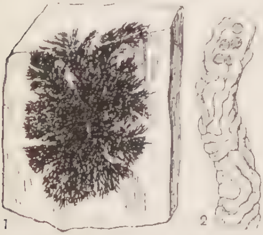


FIG. 46.—*Cænogonium ebeneum* A. L. Sm.
1. Plant on stone. 2. Filament of thallus × ca. 60.

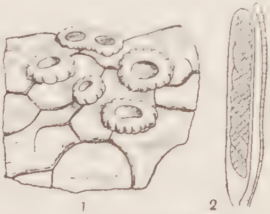


FIG. 47.—*Gyalecta cupularis* Schær.
1. Plant on rock × 4. 2. Ascus with spores and paraphysis × 250.

The genus belongs almost exclusively to warm regions; it is represented in Europe by one sterile species, dark in colour owing to the brown investing hyphæ; it grows in rather damp localities on rocks.

Wide spreading. Filaments constricted at the septa of the alga.. C. ebeneum A. L. Sm.

71. **RACODIUM** Pers.—Thallus of loose branching filaments, dark-coloured. Algal cells *Cladophora*, forming a central strand. Apothecia and spermogones unknown.

Represented by one species, found on rocks in upland regions.

Filaments not constricted	**R. rupestre Pers.**

FAMILY XIX. LECIDEACEÆ.

Thallus minutely squamulose or crustaceous. Algal cells nearly always Protococcaceæ, more rarely *Trentepohlia* or Myxophyceæ. Apothecia discoid or saucer-like (patellate), with proper margin only; spores usually 8 in the ascus, but sometimes fewer or more, simple or variously septate or muriform, colourless or coloured.

The family includes genera formerly classified under the large and comprehensive genus *Lecidea*. Apothecial and spore characters are the determining factors in classification.

*Apothecia urceolate or cup-like, brightly coloured, Spores colourless, septate or muriform	72.	**Gyalecta.**
**Apothecia discoid or patellate, coloured or blackish.		
†Spores colourless.		
§Spores simple.		
8 or fewer in the ascus	73.	**Lecidea.**
Many in the ascus	74.	**Biatorella.**
§§Spores septate.		
1-septate	75.	**Biatorina.**
3- or pluri-septate, fusiform	76.	**Bilimbia.**
Pluriseptate, acicular	77.	**Bacidia.**
††Spores brown.		
1-septate	78.	**Buellia.**
3-septate (parasitic)	79.	**Leciographa.**
†††Spores colourless or becoming brown.		
§Spores 8 in the ascus.		
Muriform (1-3-septate in *Rh. Œderi*	80.	**Rhizocarpon.**
§§Spores 1 in the ascus large.		
Elongate, pluriseptate	81.	**Bombyliospora.**
Ellipsoid, muriform	82.	**Lopadium.**

72. **GYALECTA** Ach.—Thallus granular, pulverulent or nearly obsolete. Algal cells chiefly *Trentepohlia* (*Scytonema* in *G. exanthematica*). Apothecia brightly coloured, concave with a prominent proper margin, hypothecium colourless; paraphyses discrete, unbranched; asci 8- rarely many-spored, colourless, variously septate or muriform. Spermogones with almost simple sterigmata and rather short acrogenous spermatia.

The genus is characterized by the brightly coloured apothecia, with flesh-coloured reddish or yellowish discs and whitish margins. In the early stages there may be a surrounding growth of the thallus which is not persistent. On account of a somewhat more evident double margin *G. rubra* has been classified by authors under *Lecanora* or *Phialopsis*, and because of the *Scytonema* gonidia *G. exanthematica* has been sometimes placed in the genus *Petractus*. The thalli of the latter species, both hyphæ and algæ, are deeply immersed in the calcareous rock, only a thin film appearing on the surface.

*Spores 8 in the ascus. Apothecial margin prominent.
†Spores 3-septate, ellipsoid, fusiform or oblong.
Apo. with fissured margin. On calcareous rocks or in mosses. C. .... 1. G. exanthematica Fr.
Apo. margin sometimes crenulate; spores 18–21 μ × 6–7 μ. On decayed mosses. R. .... 3. G. foveolaris Schær.
Apo. margin sometimes crenulate; spores 12 × 15 μ × 6–7 μ. On calcareous soil. S. .... 4. G. geoica Ach.
Apo. margin crenulate; spores 16–23 μ × 5–8 μ. On trees, on mosses on rocks, etc. S. .... 4a. G. rubra Wassal.
Apo. margin lacerate; spores 11–13 μ × 5–6 μ. On trees. F. .... 8. G. carneolutea Boist.
††Spores up to 13-septate,
Apo. small, with entire margin; spores 50–80 μ × 3–4 μ. On trees. S. .... 9. G. cornea A. L. Sm.
†††Spores muriform.
Apo. open, with fissured margin; spores 15–17 μ × 7–9 μ. Calcicolous. C. ..... 2. G. cupularis Schær.
Apo. with entire margin; spores oblong-fusiform, 16–23 μ × 7–9 μ. On trees. S. .... 5. G. truncigena Hepp.
Apo. with entire margin; spores ellipsoid, 11–13 μ × 8–9 μ. On trees. F. .... 6. G. Flotovii Koerb.
**Spores 24–32 in the ascus.
Apo. minute; spores fusiform, 3–7-septate, 16–34 μ × 5–7 μ. On pine. R. .... 7. G. corticola A. L. Sm.

73. **LECIDEA** Ach.—Thallus squamulose or crustaceous; hypothallus persistent or indistinct. Algal cells Protococcaceæ, rarely *Trentepohlia*. Apothecia soft and more or less waxy (biatorine), or carbonaceous and black (lecideine), with a proper margin (often obliterated); spores usually 8 in the ascus, generally ellipsoid, simple, colourless; spermogones with acicular acrogenous spermatia.

A large genus mostly with a crustaceous thallus which varies in colour from white to grey, brown or black and is often subject to great alteration or to disappearance due to weathering, etc. Apothecia and spores are fairly constant in character, the latter occasionally become brown. Apothecia are distinguished as "small" when ·5 mm. or less, large when more than 1 mm. in diameter. The size of the spores is given when of importance in determination. "Mod." or "Med." is used when the spores are from 12-18 μ long and up to 8 μ thick, "large" if beyond these measurements and small if of lesser size.

The characters adopted in the key - habitat, colouration, etc.—have been selected for their helpfulness in determination; certain species vary as to the substratum on which they grow or in their internal colouration, in which cases they are repeated under the different headings.

The genus is divided into four sections not always clearly delimited :—

Thallus squamulose	§ i. Psora (1–15).
Thallus variously crustaceous.	
Ascus 8-spored.	
Apothecia soft, generally lighter in colour	§ ii. Biatora (16–76).
Apothecia dark and carbonaceous	§ iii. Eulecidea (77–200).
Ascus 1- or 2-spored.	
Apothecia dark ; spores very large	§ iv. Mycoblastus (201–2).

§ i. Psora Haller.—Thallus squamulose, the squamules appressed or imbricate, corticate above. Apothecia more or less biatorine, adnate on the squamules.

The squamules vary in size from less than 1 mm. (small) to several mm. in diameter ; they are frequently rounded and crenulate.

A. On trees or palings.	
C+red. Pale greenish-grey, densely imbricate. C.	8. L. ostreata Schær.
Tawny, convex, appressed. small. R.	7. L. Friesii Ach.
Greyish-green or brown, subimbricate, minute. R.	9. L. acutula Nyl.
B. On soil, generally among rocks.	
*Squamules black beneath.	
Dull-brown, appressed, crowded, large. C.	1. L. lurida Ach.
**Squamules more or less white beneath.	
K ∓ y, K(C) + red Whitish, granular-squamulose. F.	31. L. (Biatora) Wallrothii Fl.
Red-brown, subimbricate, shining. R.	2. L. globifera Ach.
Pale- or tawny-brown appressed. R.	3. L. rubiformis Wahl.
Dull-brown. app.-subimbricate, whitish rhizinæ. R.	4. L. rhizobola Nyl.
Dull-greenish, solitary or congregate, contorted. R.	6. L. glaucolepidea Nyl.
Flesh-coloured or reddish, scattered, round. F.	10. L. decipiens Ach.
Dull-grey or tawny, subcontinuous, dark hypothallus. F.	13. L. demissa Th. Fr.
C. On rocks.	
Greyish, rigid, whitish beneath. Cal. R.	5. L. testacea Ach.
Dull-grey, contiguous or dispersed, small. R.	12. L. confertula Stirt.
Pinkish-grey, on black hypothallus, thin. R.	12a. L. prostratula Stirt.
Chocolate-brown, areolate (*Psorotichia*). F.	11. L. lugubris Sommerf.
Whitish, tumid. C.	23. L. coarctata var. glebulosa Cromb.

§ ii. Biatora Th. Fr.—Apothecia plane or convex with margin excluded, mostly small, soft and often brightly coloured, rarely becoming black, asci usually 8-spored (12–18 in *L. pleiospora*) ; spore-sizes given when distinctive.

The thallus is crustaceous, rarely subsquamulose, sometimes evanescent.

1. Spores usually ellipsoid.	
A. Trees stumps, or palings.	
*Thallus whitish, greyish or greyish-green, effuse.	
†Hypothecium colourless or pale.	
Kf + y. Apo. cinnabarine-red; sp. small. R.	16. L. cinnabarina Sommerf.
Kf + y, C + red. Apo. yellow to black; sp. 9–16 μ × 4–7 μ. Stumps. F.	27. L. granulosa Schær.
Kf + y, C + red. Apo. blackish; sp. small, F.	28. L. flexuosa Nyl.
Th. leprose, green. C.	f. æruginosa Leight.
Apo. pale; sp. 8–14 μ × 2–3 μ (cf. *Biatorina graniformis*). R.	49. L. albo-hyalina Nyl.
Apo. pale-reddish; sp. 10–18 μ × 4–5 μ. F.	38. L. vernalis subsp. minor Nyl.
Apo. red-brown; sp. 8–15 μ × 4–5 μ. F.	40. L. tenebricosa Nyl.
Apo. red-brown; sp. up to 16 × 11 μ with epispore. S.	58. L. mutabilis Fée.
Apo. brown-black, minute; sp. up to 16 × 6 μ. R.	58a. L. filamentosa Stirt.
††Hypothecium yellow or brownish (becoming dark *L. turgidula*).	
Apo. orange to black, minute; sp. small (on firs). R.	39. L. meiocarpa Nyl.
Apo. brown to black, sometimes pruinose; sp. small. F.	53. L. turgidula Fée.
Apo. red-brown; sp. mod. with epispore. S.	58. L. mutabilis Fr.
Apo. dark, violet granules in hymenium; sp. mod. On moss. F.	45. L. sanguineoatra Ach.
**Thallus yellowish or yellow-green.	
†Hypothecium pale. Spores small.	
K + y, K(C) + red. Apo. red-brown; sp. ovoid, small. Oak. C.	19. L. quernea Ach.
Apo. red-brown with margin; sp. narrow. Pines. R.	43. L. ochrococca Nyl.
Apo. pale-lemon; sp. minute. (Rare on trees.) C.	17. L. lucida Ach.
††Hypothecium brownish.	
Kf + y, K(C) + red. Apo. dark; sp. small. S.	29. L. irridescens Ach.
Apo. dark, violet to black within; sp. minute. R.	56. L. misella Ach.
***Thallus dark, thin or evanescent.	
†Hypothecium colourless or pale.	
Apo. pale orange; sp. small. Holly stumps. R.	70. L. micrococca Nyl.
Apo. black; sp. small. Fir pales. R.	35. L. perobscura Nyl.

Apo. black; paraph. brown capitate; sp. small. F.	188. L. nigroclavata Nyl.
Apo. black; sp. globose, minute. R. ...	186. L. antiloga Stirt.
††Hypothecium brown or brownish.	
Th. granular. Apo. red-brown; sp. mod. Wood. C.	34. L. fuliginea Ach.
Th. thin. Apo. dark; sp. small. Wood. R.	54. L. moestula Nyl.
B. Peaty ground or stumps.	
*Thallus light in colour. Hypothecium pale.	
K + y, C + red. Apo. yellow to blackish; sp. mod. C.	27. L. granulosa Schær.
K + y. Apo. yellow, pruinose; sp. small. R.	36. L. epimarta Nyl.
Th. sorediose. Apo. dark-red; sp. small. R.	30. L. gelatinosa subsp. prasinorufa Nyl.
**Thallus dark. Hypothecium dark (pale in *L. demissa*).	
Sq. adnate. Apo. dark; sp. mod. F.	32. L. demissa Th. Fr.
Subleprose. Apo. dark; sp. mod. C.	33. L. uliginosa Ach.
C. On soil. Thallus various.	
†Hypothecium colourless or pale-brown.	
K + y, K (C) + red. Thick gran.-squam., whitish. Apo. large; sp. large. F. ..	31. L. Wallrothii Fl.
Thin, greenish. Apo. dark; sp. small. S.	30. L. gelatinosa Fl.
Thick, dark, sq. continuous. Apo. dark; sp. mod. F.	32. L. demissa Th. Fr.
††Hypothecium brown or dark.	
Thick, light. Apo. red; sp. 9–21 μ × 3–6 μ. Alpine. R.	41. L cuprea Sommerf.
Thick, light. Apo. black; 10–18 μ × 4–6 μ. Alpine. R.	42. L. Berengeriana Th. Fr.
Thin, dark. Apo. dark; sp. mod. C. ..	33. L. uliginosa Ach.
D. Mosses on soil, rocks or trees.	
*Thallus light-coloured, thin. Hypothecium colourless or pale (brown in *L. sanguineoatra*).	
Apo. reddish, shining; sp. 11–23 μ × 4–7 μ	38. L. vernalis Ach.
Apo. brown, pruinose; sp. mod. R.	37. L. æstivalis Ohl.
Apo. dark; sp. small. Occasionally on ground mosses	30. L. gelatinosa Fl.
Apo. dark, violet granules in hymenium; sp. mod. F.	45. L. sanguineoatra Ach.
Spores often 1-sept. Alpine. F.	Subsp. atrofusca Nyl.
Apo. larger; sp. often 1-sept. S.	Var. Tempeltoni Wain.
**Thallus dark.	
Subleprose. Apo. black; hypo. dark; sp. mod. C.	33. L. uliginosa Ach.
Thin. Apo. black; hypo. pale; sp. large. Alpine. R.	59. L. breadalbensis Stirt.

E. On rocks, mainly calcareous.

*Thallus thin, whitish. Hypothecium brownish.	
Apo. in pits, black, often pruinose; sp. mod. C.	50. L. immersa Ach.
Apo. in pits, black, naked; sp. large. F.	51. L. Metzleri Th. Fr.
**Thallus thin, dark. Hypothecium dark-brown.	
Apo. brown-black; epi. brown; sp. small. F.	52. L. ochracea Wedd.
Apo. brown-black; epi. pale-reddish; sp. mod. R.	48. L. fuscorubens Nyl.

F. Siliceous rocks in or near streams.

Thallus various. Hypothecium red- or dark-brown.	
Kf + y. Thick, smooth, greenish-grey. Apo. red-brown; sp. mod. F.	20. L. phæops Nyl.
Kf + y. Sordid white. Apo. pale then dark; sp. small. R.	46. L. semipallens Nyl.
Greenish. Apo. dark-brown; sp. mod. R.	47. L. valentior Nyl.
Whitish. Apo. dark-brown; sp. small. R.	57. L. paucula Nyl.
Dark. Apo. blackish, minute; sp. small. R.	60. L. poliodes Nyl.

G. On rocks, mainly siliceous.

*Thallus light-coloured (yellowish in *L. lucida*).	
†Hypothecium colourless.	
§Apothecia brightly coloured.	
K + y. Thick, continuous. Apo. yellow; sp. large. R.	62. L. Henrica Larb.
Thin. Apo. rose; sp. mod. R.	26. L. arridens Nyl.
Thin. Apo. yellow; sp. 4–6 μ × 1–3 μ. C.	17. L. lucida Ach.
Thin. Apo. yellow; sp. 8–10 μ × 2–3 μ. S.	66. L. tenera Nyl.
§§Apothecia becoming blackish: first colour indicated.	
Kf + y. Thin. Apo. brown; sp. mod. S.	21. L. lithophiliza Nyl.
K + y. Thickish. Apo. red-brown; sp. large. F.	22. L. Gagei A. L. Sm.
Kf + y, C + red. Thin. Apo. often with white margin; sp. large, rose-pink at first. C.	23. L. coarctata Nyl.
Kf + y, C + red. Sorediate (probably form of *L. coarctata*). R.	24. L. prærimata Leight.
Thin. Apo. dull-yellow or red; sp. minute. R.	18. L. clavulifera Nyl.
Squamulose. Apo. red-brown. (See under *Psora*)	32. L. demissa Th. Fr.

††Hypothecium yellowish or brownish to dark-brown. Apothecia variously coloured. Thallus light.	
K + y. Thickish; sp. large	22. L. Gagei A. L. Sm.
K + y. Thin, smooth. Apo. innate brown; sp. mod. F.	20. L. phæops Nyl.
Kf + y. K(C) + y. Granulate. Apo. black; sp. mod. R.	63. L. rusticula Nyl.
K + reddish. Subleprose. Apo. black; sp. small. R.	64. L. rusticella Nyl.
Leprose. Apo. yellow-red; sp. small. In caves. R.	67. L. antrophila Larb.
Thin, areolate. Apo. brown, often aggregate; sp. small. R.	71. L. botryza Nyl.
Subleprose. Apo. dark-brown; sp. small. On flints. S.	52. L. ochracea Wedd.
Granulose. Apo. black; sp. small. Maritime. R.	55. L. submœstula Nyl.
†††Hypothecium brownish-black. Apothecia dark.	
K(C) + y. Dull-yellow. Apo. large, concave; sp. 18–21 μ × 8–11 μ. R.	25. L. Brujeriana Nyl.
C + red. Whitish. Apo. angular; sp. small. R.	65. L. livescens Leight.
Dull-white. Apo. confluent; sp. small. S.	68. L. picila Leight.
Whitish. Apo. plane; sp. mod. R.	69. L. indigula Nyl.
††††Hypothecium or Hymenium cœruleous-blue or violet. Apothecia black (*Biatora* or *Eulecidea*). All rare.	
Thallus light-coloured. Hypothecium blackish.	
Thin, finely areolate. Hym. blue; sp. large	112a. L. petrosa Arn.
Smooth, often reddish. Hym. grey-blue; sp. small	112b. L. mersata Stirt.
Whitish or obsolete. Hym. grey-blue; sp. small	138. L. sarcogynoides Koerb.
**Thallus dark.	
Dull-grey. Hypo. blue; sp. small	13a. L. hypocyanea Stirt.

2. Spores globose or subglobose. (*Biatora* or *Eulecidea*. Rare.)

Hypothecium pale, thallus various.	
Thick, whitish. Apo. black; sp. 5–9 μ. Boulders	74. L. leptostigma Nyl.
Thin. Apo. red; sp. 6–7 μ. Cal.	76. L. rubidula Nyl.
Evanescent. Apo. dark; sp. 4–5 μ. Palings	186. L. antiloga Stirt.
Dark. Apo. dark; sp. 4–5 μ. Wood	186a. L. dasæa Stirt.
Thin, greenish. Sp. 12–18 in ascus 6–8 μ. Soil	76a. L. pleiospora A. L. Sm.

§ iii. EULECIDEA Nyl.—Apothecia dark-coloured-brown or black, and more or less carbonaceous, plane with a persistent proper margin, or becoming convex and immarginate, moderate in size (about 1 mm. across), large (more than 1 mm.), small or minute (less than 1 mm.); spores usually 8 in the ascus, generally ellipsoid.

The species, as in the previous section, are grouped according to habitat, but the large majority grow on siliceous rocks, and many of those marked "rare" have only been found in hilly regions. The student is advised to refer also to § *Biatora*, as a few species that seem to belong to one group may be classified in another. In some species, as in *L. limborina*, *L. rivulosa* and *L. Kochiana*, the spores become brownish by degeneration.

A. On trees or on pales.

*Hypothecium colourless, yellowish or brownish. Thallus light, various.	
K + y, C + O. Pulverulent or smooth. Epi. blue-green; sp. mod. F.	78. L. dubia Hook.
K + y, C + O. Yellowish, granular. Sp. small. R.	79. L. sporodiza Stirt.
Kf + y, K(C) + red. Granular or smooth. Epi. blue-green; sp. mod. C.	80. L. parasema Ach.
Thin, greyish-brown. Paraph. brown, capitate; sp. small. F.	188. L. nigroclavata Nyl.
Evanescent. Epi. dark; sp. globose, small. R.	186. L. antiloga Stirt.
**Hypothecium dark.	
K + y. Yellowish. Epi. blackish; sp. small. Stumps. R.	189. L. xanthococca Sommerf.

B. On mosses or on soil (Alpine or subalpine).

*Hypothecium colourless or pale-brown. Thallus light (grey).	
Kf + y, C + red. Papillose. Epi. greenish-black; sp. mod.	99. L. arctica Sommerf.
Kf + y. Granular. Epi. blue-green or brown; sp. 14–25 $\mu \times$ 3–4 μ. R.	101. L. alpestris Sommerf.
Furfuraceous. Epi. blue-green or brown; sp. mod. R.	100. L. limosa Ach.
**Hypothecium brown or dark.	
K + y. Minute dull-grey granules. Epi. dark-brown; sp. small. R.	179. L. neglecta Nyl.

C. On other lichens (often placed under fungi).

*Thallus none. Hypothecium brownish.	
Apo. small, black; epi. greenish-black. On *Lecanora vitellina*. S.	97. L. vitellinaria Nyl. (*Nesolechia*).
Apo. minute black; epi. brown. On *Cetraria* and *Parmelia*. F.	196. L. oxyspora Nyl. (*Nesolechia*).
**Thallus grey-brown. (Hypo. and epi. dark-brown.)	
K + y. Areolate. Apo. small. On *Lecanora sordida*. F.	172. L. insularis Nyl.

D. On rocks mainly calcareous.

*Hypothecium colourless or pale. Thallus various.

K + y. Thin, granulate, grey or brownish. Epi. dark; sp. mod. C. .... 83. L. goniophila Schær.

Kf + y. Thick, greenish. Apo. minute; epi. dark; sp. small. R. .... 131. L. mesotropoides Nyl.

**Hypothecium dark.

†Thallus whitish.

Thin. Apo. mod.; epi. blackish; sp. mod. F. .... 106. L. jurana Schær.

Thin. Apo. blue within; epi. dark-greenish-blue; sp. large. R. ...... 112a. L. petrosa Arn.

Areolate. Apo. innate at first; epi. dark-brown; sp. small. F. 122. L. cinerascens A. L. Sm.

Thin, scurfy-grey or brown. Apo. often in lines; sp. mod. F. 117. L. crustulata var. meiospora Oliv.

††Thallus blackish.

Thin. Apo. minute; epi. sordid-blue; sp. small.................................. 177. L. advertens Nyl.

E. On rocks mainly siliceous.

*Hypothecium colourless or pale.

†Paraphyses dark-greenish-blue at the tips (clear blue in *L. assimilis*). Thallus variously coloured.

Kf + y. Thin, granular, grey or brown. Sp. mod. F. .... 80. L. goniophila Schær.

Kf + y, K(C) + red. Thin, granulose, greenish. Sp. small. R. .... 85. L. viridans Koerb.

K + y. Thickish, verrucose, whitish. Sp. small. R. .... 132. L. mesotropiza Nyl.

K + y. Thick, tumid, yellow-white. Sp. mod. F. .... 145. L. aglæa Sommerf.

Sulphur-yellow .... Var. Crombiei Nyl.

Thickish, cracked, grey. Sp. subglobose, small. R. .... 153. L. mollis Nyl.

Thin, cracked, plane, whitish. Apo. plane; sp. small. F. .... 127. L. lapicida Ach.

Thin, cracked, tawny or grey. Sp. small. F. 182. L. sylvicola var. infidula Cromb.

Thin, warted, tawny. Sp. small, with epispore. R. .... 191. L. assimilis Th. Fr.

Thin, dark-olive-grey. Sp. small. R. ... 183. L. aphanoides Nyl.

Thin, cracked, blackish. Sp. small. R. 174. L. nigrificans Nyl.

Thickish, granular, blackish. Sp. small. R. .... 171. L. asperella Stirt.

††Paraphyses brownish to dark-brown at tips.

§Thallus whitish or light-cinereous-grey.

Kf + y. Granular. Sp. mod. F. ...... 83. L. goniophila Schær.

Kf + y. Granulate. Apo. excipulum K + p; sp. small. R. .... 139a. L. pilati Koerb.

K + y. Areolate; black hypothallus. Sp. small. R. .... 155. L. interludens Nyl.
K + y then o. Verrucose. Sp. mod. R. 88. L. leucophæoides Nyl.
K + y then red? Plane, cracked. Apo. plane; sp. small. F. ...... 127. L. lapicida Ach.
K + y then red. Smooth, areolate. Apo. innate; sp. small. R. ...... 135. L. subkochiana Cromb.
K(C) + reddish. Areolate. Apo. adnate; sp. small. R. .... 130. L. mesotropa Nyl.
K + y K(C) + red. Areolate. Apo. convex; sp. mod. R. .... 89. L. discolorella Nyl.
Areolate. Apo. reddish-brown to black; sp. small. F. .... 87. L. leucophæa Nyl.
Plane, cracked. Apo. velvety-black; sp. small. F. .... 128. L. lithophila Ach.
Effuse. Apo. thin, crowded; sp. 9–12 μ × 2–4 μ. F. .... 129. L. plana Nyl.
Granulate, whitish. Apo. small; sp. mod. R. .... 96. L. aggregatula Nyl.
Areolate, dark-blue-grey. Apo. plane to convex; sp. mod. R. .... 84. L. inserena Nyl.

§§Thallus yellow or reddish.

K + y then cr. Ochraceous, cracked. Sp. small. R. .... 146. L. armeniaca Fr.
K + y. Pale-apricot, in patches. Sp. mod. R. .... 147. L. marginata Schær.
Yellow- or rusty-red. Sp. small. S. ... 128. L. lithophila f. ochracea Nyl.

§§§Thallus brownish-grey or brown.

Kf + y. Granular. Sp. mod. F. ...... 83. L. goniophila Schær.
Kf + y. Areolate, tawny. Sp. mod. R. 92. L. ænea Duf.
K + y. Granular, pale-tawny. Sp. mod. Flints. R. .... 119. L. prominula Borr.
K + y. Tartareous, pale-brown. Sp. small. R. .. .. 120. L. polyantha Tayl.
Thick, with heavy lines, mouse-brown. Sp. small, curved. C. .... 151. L. rivulosa Ach.
Thick, mouse-brown. Sp. small, subglobose. F. .... 152. L. Kochiana Hepp.
Granular-scattered, grey-brown. Sp. small. R. .... 173. L. confusula Nyl.
Areolate, dark-grey. Sp. small, thick-walled. R. .... 158. L. tenebrica Nyl.
Granulate patches, grey-brown. Sp. mod. R. .... 86. L. asema Nyl.
Effuse, grey-brown. Paraph. brown-capitate. F. .... 188. L. nigroclavata Nyl.
Thin, dark-shiny-brown. Sp. small, subglobose. R. .... 175. L. leiotea Nyl.

§§§§Thallus almost black.

Thin blackish stain. Sp. small. R. ... 157. L. periplaca Nyl.
Leathery, grey-black. Sp. small. R. ... 156. L. coriacella Nyl.

Smooth, brown-black. Sp. 18–20 μ × 9–11 μ. R. .... 162. L. atrofuscescens Nyl.

Smooth, sometimes blackish. Sp. small. R. .... 175. L. leiotea Nyl.

†††Paraphyses black at tips (brownish, blue- or green-black).

K + y then red? Areolate, whitish. Sp. small. F. .... 127. L. lapicida Ach.

K + y. Minutely squamulose, white. Sp. mod. R. 94. L. nigroglomerata Leight.

Med. I + red. Areolate, pale- or dark-grey. Sp. mod. F. .... 160. L. griseoatra Schær.

Areolate, pale-grey. Sp. small. R. ...... 126. L. tessellata Fl.

Areolate, greenish - yellow. Sp. mod. R. .... 90. L. viridiatra Schær.

Areolate, dark-grey. Sp. 16–18 μ × 5–6 μ, sometimes septate. R. .... 95. L. scotinodes Nyl.

**Hypothecium brown or brownish-black.

†Paraphyses pale-blue at the tips.

Kf + y, K(C) + reddish. Granular, yellowish. Sp. mod. R. .... 176. L. alienata Nyl.

††Paraphyses dark-greenish-blue at tips.

§Thallus light in colour.

K + y, C + red. Thick, granular greenish. Sp. mod. F. .... 77. L. protrusa Fr.

K + y, C + red. Thick, gran.-areolate, grey. Sp. mod. F. .... 81. L. latypea Ach.

Kf + y to reddish? Thin, cracked, grey. Sp. small. S. .... 127. L. lapicida Ach.

K + y. Thick, tumid, yellowish. Sp. mod. F. .... 145. L. aglæa Sommerf.

Granulate, patchy, brownish. Sp. mod. R. .... 86. L. asema Nyl.

Granular, whitish, dark hypothallus. Sp. small. S. .... 82. L. sublatypea Leight.

Thin, sparse, grey. Apo. difform; sp. small. R. .... 103. L. deparcula Nyl.

Areolate (or absent), grey. Apo. lobate; sp. small. F. .... 137. L. auriculata Th. Fr.

Scurfy, tawny. Apo. small; sp. small. F. .... 182. L. sylvicola Flot.

Smooth, white. Apo. plane, pruinose; sp. large. R. 116. L. albocærulescens var. smaragdula Knowles.

§§Thallus dark (blackish).

Subeffuse unequal. Sp. 11–19 μ × 4–6 μ. R. .... 184. L. melaphana Nyl.

Granular. Apo. small; sp. small. R. 171. L. asperella Stirt.

†††Paraphyses brown to dark-brown at tips.

§Thallus sorediate.

Greyish. Apo. pruinose; sp. large. S. 114. L. sorediza Nyl.

§§Thallus with (sometimes without) cephalodia.

K(C) + red. Tumid-areolate, whitish. Sp. 17–27 μ × 8–12 μ. F. .... 110. L. panæola Ach.

Plane-areolate, whitish. Sp. 27–38 μ × 16–22 μ. R. .... 109. L. consentiens Nyl.

§§§Thallus light-coloured.

K + y. Thickish, granular. Apo. large, minute; sp. small. R. .... 91. L. endomelæna Leight.

K + y. Warted, grey. Apo. aggregate; sp. mod. S. .... 190. L. pycnocarpa Koerb.

K + y to reddish? Disappearing. Sp. small. S. 127. L. lapicida var. declinans Nyl.

Med. I + blue. Areolate grey. Apo. often confluent; sp. small. C. ...... 121. L. confluens Ach.

Med. I + blue. Subeffuse, whitish. Apo. subpruinose; sp. mod. F. .... 122. L. cinerascens A. L. Sm.

Scanty, yellowish. Apo. subpruinose; sp. large. R. .... 112. L. phæenterodes Nyl.

Effuse, white. Apo. minute, umbonate; sp. large. R. .... 107. L. subumbonella Lamy.

Areolate, grey. Apo. large, plicate; sp. large. R. .... 108. L. contortula Stirt.

Areolate, white. Apo. small, plicate; sp. small. R. .... 104. L. dealbatula Nyl.

Areolate, grey. Apo. minute, innate; sp. small. R. .... 150. L. macula Tayl.

Areolate, whitish. Apo. pale-blue within; sp. 16–30 μ × 9–13 μ. R. ... 112a. L. petrosa Arn.

Variable, grey. Apo. innate at first; sp. 16–27 μ × 8–13 μ. C. .... 113. L. contigua Fr.

Apo. sessile, plane. C. .... Var. platycarpa Fr.

Scurfy, grey or brown. Apo. small; sp. mod. C. .... 117. L. crustulata Koerb.

Areolate, brownish. Apo. small; sp. small. F. .... 118. L. sympathetica Tayl.

Effuse, brownish. Apo. large; sp. small. R. .... 123. L. Mooreana Carroll.

Granulate, grey or brown. Apo. lobate; sp. small. F. .... 137. L. auriculata Th. Fr.

Thallus wanting .... Var. diducens Th. Fr.

§§§§Thallus more or less yellow or red (see *Lecanora Dicksonii*).

Rusty-red, smooth, areolate. Sp. large. F. 113. L. contigua var. flavicunda Nyl.

Rusty-red or yellowish. Sp. small. S. 121. L. confluens f. oxydata Leight.

Sulphur or whitish-yellow. R. .... 145. L. aglæa f. Crombiei Nyl.

§§§§§Thallus dark-grey, -brown or blackish.

K + y. Unequal. Sp. small. F. (on *Lecanora sordida*) .... 172. L. insularis Nyl.

Med. K + y. Granulate. Apo. plicate; sp. mod. R. .... 161. L. fuscocinerea Tayl.

Scurfy. Apo. small, plicate; sp. mod. R. 144. L. subgyratula Nyl.
Subsquamulose. Apo. small; sp. small. S. .... 98. L. fuliginosa Tayl.
Scurfy. Apo. minute; sp. small. F. ... 185. L. expansa Nyl.
Thin, scattered. Apo. larger; sp. small. R. 192. L. commaculans Nyl.
Thick, granular-areolate. Apo. small; sp. mod. F. .... 170. L. furvella Nyl.

††††Paraphyses black at tips (brownish-, bluish or greenish-black).

§Thallus light, white to grey.

K + y, then red. Areolate, smooth. Apo. plane; sp. mod. F. .... 134. L. lactea Floerke.
K + y. Patchy, smooth. Apo. small, umbonate; sp. mod. R. .... 140. L. umbonella Nyl.
K + y, C + rd. Granular-areolate. Sp. mod. F. .... 81. L. latypea Ach.
C + red. Plane, areolate. Apo. subpruinose; sp. mod. F. 148. L. fuscoatra var. grisella Nyl.
Med. I + violet. Disappearing. Sp. 8–14 μ × 3–4 μ. R. .... 124. L. promiscens Nyl.
Smooth. Apo. pruinose; sp. 20–28 μ × 7–10 μ. C. .... 116. L. albocœrulescens Nyl.
Areolate. Apo. angular; sp. mod. R. 136. L. contiguella Nyl.
In patches. Apo. minute, plane; sp. small. In streams. R. .... 142. L. alumnula Nyl.
Scanty. Apo. minute, convex; sp. 8–14 μ × 3–4 μ. R. .... 187. L. enclitica Nyl.

§§Thallus yellow, ferruginous.

Med. I + blue. Tumid, areolate. Apo. plane or convex; sp. small. S. ... 125. L. silacea Ach.

§§§Thallus brownish or brownish-grey.

Granulate, patchy. Apo. plicate; sp. mod. R. .... 86. L. asema Nyl.
Scurfy. Apo. small; sp. mod. C. ...... 117. L. crustulata Koerb.
Granulate. Apo. lobate; sp. small. F. 137. L. auriculata Th. Fr.
Apo. aggregate .... Var. diducens Th. Fr.

§§§§Thallus dark-brown or blackish.

K + y. Areolate, smooth. Apo. large; sp. small. R. .... 159. L. contenebricans Nyl.
C + red. Areolate, shining. Apo. mod; sp. mod. F. .... 148. L. fuscoatra Ach.
Apo. pruinose. F. .... Var. Mosigii Nyl.
Areolate, smooth. Sp. 18–24 μ × 10–15 μ. R. .... 115. L. tenebrans Nyl.
Subsquamulose. Apo. small; sp. small. S. .... 98. L. fuliginosa Tayl.
Furfuraceous. Apo. small; sp. subglobose. S. .... 102. L. subfurva Nyl.
Scattered, thin. Apo. minute, aggregate; sp. mod. R. .... 105. L. tabidula Nyl.
Granulate-areolate. Apo. crowded; sp. small. R. .... 149. L. nigrogrisea Nyl.

Granular-cracked. Apo. small; sp. mod. F.	170. L. furvella Nyl.
Thin, effuse. Apo. small; sp. 18–30 μ × 11–16 μ (brown). R.	143. L. limborina A. L. Sm.
Apothecia sometimes in lines	117. L. crustulata var. meiospora Oliv. 148. L. fuscoatra var. grisella Nyl.

§ iv. MYCOBLASTUS Th. Fr.—Thallus crustaceous. Spores usually 1, rarely 2 or 3 in the ascus.

The principal British species is characterized by the blood-red colour of the medullary tissue under the apothecia, and by the large spores with a broad epispore. It grows on rocks or on mosses encrusting boulders, also on palings and on trees, chiefly firs.

K + y. Thickish, granulose, whitish. Sp. 70–100 μ × 28–38 μ. C.	201. L. sanguinaria Ach.
Thin; spore smaller. R.	f. microcarpa Nyl.
Med. colourless. Sp. as in species. R.	Var. affinis Nyl.
Sp. 2 in ascus, smaller. R.	Var. melina Nyl.
Granulose, grey. Apo. violet within; sp. 1–3, up to 48 μ × 22 μ. Wood. R.	202. L. fucata Stirt.

74. **BIATORELLA** De Not. Thallus, effuse or determinate, rarely obsolete. Algal cells Protococcaceæ. Apothecia light-coloured (biatorine), or dark and carbonaceous (lecideine); asci many-spored, the spores minute, simple, oblong or round, colourless. Spermogones with ovoid or shortly cylindrical spermatia.

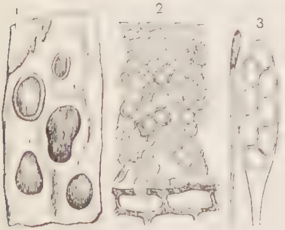


FIG. 48.—*Lecidea parasema* Ach.
1. Plant on bark × ca. 10. 2. Vertical section of thallus × 350. 3. Ascus with spores and paraphysis × 350.

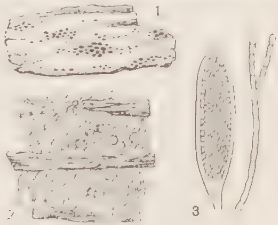


FIG. 49.—*Biatorella moriformis* Th. Fr.
1. Plant on wood. 2. Vertical section of thallus and wood fibres × 250. 3. Ascus with spores and paraphysis × 200.

The genus corresponds in spore formation with *Acarospora* (Lecanoraceæ); (compare also the polyspored *Lithographæ*); it is divided into two sections:—

Apothecia mostly soft and pale within	§ i. EUBIATORELLA.
Apothecia more or less carbonaceous	§ ii. SARCOGYNE.

§ i. Eubiatorella Th. Fr.—Thallus mostly thin or indistinct. Light or dark. Apothecia biatorine.

A. Growing on trees or on pales.

*Apothecia light-coloured ; spores globose.
Whitish. Apo. reddish-yellow, pruinose ; sp. 4–5 μ. Mossy trees. R. .... 2. B. ochrophora Th. Fr.
Grey. Apo. reddish ; sp. 3–4 μ. Resinous bark. F. .... 4. B. resinæ Th. Fr.
**Apothecia dark-coloured, spores globose.
K + y, C + red. Grey or brownish. Hypo. pale ; sp. 2·5–3–5 μ. Pales. F. ...... 3. B. moriformis Th. Fr.
Indistinct. Hypo. brown ; sp. 2·5 μ. Resinous bark. R. .... 5. B. difformis Wain.

B. Mosses or soil (*B. Morio* on rocks).

Greyish. Apo. red ; sp. 6–12 μ × 3–4 μ. Alpine. R. .... 1. B. fossarum Th. Fr.
Grey or green, scanty. Apo. pale ; sp. 7–8 μ × 3 μ. R. .... 6a. B. campestris Th. Fr.
Blackish, areolate. Apo. black ; sp. 2·4 μ × 2–3 μ. S. .... 6. B. Morio Mudd.

§ ii. Sarcogyne Th. Fr. Thallus superficial or immersed, light or dark. Apothecia lecideine ; spores oblong or ellipsoid.

On rocks.

*Thallus evident. Hypothecium colourless or pale.
Greyish, powdery. Apo. pruinose ; sp. 4–5 μ × 2 μ. Cal. C. .... 7. B. pruinosa Mudd.
, Apo. without pruina. Cal. or Sil. F.... f. nuda A. L. Sm.
Dull-green, thickish. Apo. red-black ; sp. 5–6 μ × 1–2 μ. R. .... 8. B. hypophæa A. L. Sm.
Dull-brown, thickish. Apo. black ; sp. 3 μ × 1–2 μ. Cal. R. .... 9. B. flava A. L. Sm.
**Thallus immersed or obsolete. Hypothecium pale (black in *B. clavus*). Spores minute.
Apo. large, margin crenate. Sil. R. ...... 10. B. clavus Th. Fr.
Apo. mod. irregular, margin entire. Sil. R. 11. B. privigna A. L. Sm.
Apo. minute, plicate. Sil. or Cal. F. ...... 12. B. simplex Br. & Rostr.

75. **BIATORINA** Massal. Thallus minutely squamulose or variously crustaceous, sometimes evanescent. Algal cells Protococcaceæ or rarely *Trentepohlia*. Apothecia light-coloured and biatorine or dark-coloured and more lecideine, the proper margin often obliterated ; spores usually 8 in the ascus, ellipsoid or oblong-fusiform, usually 1-septate, colourless.

Trentepohlia algæ form the gonidia of *Biatorina lutea* and *B. diluta*, and these species, for that reason, and also on account of the prominent margins, have sometimes been classified under *Microphiale* (Gyalectaceæ).

The apothecia in this and the following genera are usually rather small, 1 mm. and less in diameter ; the spores in *B. cyrtella* number 8 to 16, and in that species, as well as in *B. Arnoldi*, they may be occasionally 2-septate; they are mostly narrow in proportion to their length. In light-coloured apothecia the internal tissues are light-coloured; in dark apothecia, the colour of the disc is mostly due to the dark-coloured tips of the paraphyses. Spores are reckoned "moderate" in size when they are 12 to 18 μ long, 6 to 8 μ thick, and "small" when the measurements are constantly less. There is a violet reaction with potash in the hymenium of *B. synothea*, and of *B. chalybeia* subsp. *chloroscotina*.

A. On bark, leaves or pales.
*Apothecia light in colour; spores various; hypothecium pale.
†Thallus whitish, grey or green (yellowish in *B. graniformis*).
(Apo. minute, pale flesh-coloured; sp. 14 μ × 2–3 μ, often 1-septate *Lecidea albohyalina* Nyl.)
Apo. yellowish; sp. small. Leaves of box-tree. R. .... 16. B. Bouteillei Arn.
Apo. yellow, marginate; sp. small. Bark. F. .... 5. B. lutea Arn.
Apo. yellow, marginate; sp. small. Pines. F. .... 6. B. diluta Th. Fr.
Apo. pale-reddish, plane; sp. mod. Beech. R. 12. B. subsphæroides A. L. Sm.
Apo. yellow, globose; sp. mod. Mossy trees. F. .... 11. B. pilularis Koerb.
Apo. pale-yellow, plane then convex; sp. 8–11 μ × 2–3 μ. Pales. F. ... 13. B. graniformis A. L. Sm.
Apo. reddish-yellow, convex; sp. 7–10 μ × 3–5 μ. Pales. S. .... 17. B. erysiboides Th. Fr.
††Thallus dark-coloured.
K(C) + red. Apo. pale or darkish, subconvex; sp. mod. Fir pales. R. .... 21. B. spodiza A. L. Sm.
Apo. yellowish, convex; sp. small. Elm bark. R. .... 20. B. fallax A. L. Sm.
**Apothecia light then dark; hypothecium pale.
†Thallus whitish. On bark.
K + y. Apo. pale to blackish; sp. 10–20 μ × 4–5 μ. C. .... 15. B. Griffithii Massal.
Apo. brown to blackish; sp. (8 to 16) mod. F. .... 14. B. cyrtella Th. Fr.
***Apothecia dark-coloured, mostly blackish; spores various. Thallus greyish or greenish (sometimes dark in *B. synothea*).
†Hypothecium pale.
K + y. Apo. large, plane; sp. 15–19 μ × 7–9 μ. On old trees. F. ...... 24. B. pulverea Mudd.
Apo. small, convex; sp. 9–14 μ × 2–4 μ. Bark and wood. F. .... 19. B. globulosa Koerb.

Apo. minute, convex; sp. small. Old trees. R.	18. B. prasina Syd.
Apo. small, convex (epi. K + violet); sp. small, sometimes curved. Palings. F.	22. B. synothea Koerb.
Apo. moderate subinnate, rather plane; sp. 7–10 μ × 3–4 μ. Smooth trees or firs. F.	25. B. Lightfootii Mudd.
Apo. small, plane; sp. 11–15 μ × 5–7 μ. Old trees. F.	26. B. atropurpurea Massal
††Hypothecium dark-coloured.	
K + y. Apo. plane, moderate; sp. 15–18 μ × 6–7 μ. Bark. R.	27. B. intermixta A. L. Sm.
Apo. plane, large, papillate; sp. 20–30 μ × 8–18 μ. Trunks. C.	23. B. premnea A. L. Sm.
B. Growing on soil or on mosses.	
*Thallus squamulose, whitish (apothecia dark). (See also *B. cæruleo-nigricans*.)	
Apo. plane or convex; hypo. pale-reddish; sp. 16–23 μ × 3–5 μ. Mossy rocks (calcareous) or soil. R.	2. B. candida Jatta.
Apo. plane then convex; hypo. reddish-black; sp. 12 μ × 6 μ. S. R.	3. B. tumidula A. L. Sm.
(Thallus granulose squamulose. Sp. often 1-septate, 14–24 μ × 3–6 μ.	7. *Bilimbia sabulosa* Massal.)
**Thallus squamulose, dark. Apothecia dark.	
K + y. Th. grey or black hypothallus. Sp. 13–18 μ × 4–6 μ. Alpine; very rare	4. B. cumulata Th. Fr.
Th. bluish-black, pruinose. Sp. 18–30 μ × 4–6 μ. Chiefly limey soil. C.	1. B. cæruleonigricans A. L. Sm.
***Thallus crustaceous.	
(Greyish. Apo. inspersed with violet granules; sp. 10–15 μ × 5–6 μ. R.	*Lecidea sanguineoatra* var. *Tempeltoni* Wain.)
Thin, greyish. Apo. light; sp. 11–20 μ × 5–6 μ. S.	11. B. pilularis Koerb.
K + y. Thick, light. Apo. large, dark; sp. 15–19 μ × 7–9 μ. Mossy rocks. R.	24. B. pulverea Mudd.
Thin, dark. Apo. small; sp. 10–14 μ × 3–4 μ. Mossy rocks. R.	35. B. contristans A. L. Sm.
C. Growing on rocks (siliceous except *B. Arnoldi*).	
*Thallus light-coloured.	
†Apothecia light-coloured.	
Yellowish. Apo. pale to brown, with white margin; sp. 10–18 μ × 4–6 μ. R.	9. B. bæomma A. L. Sm.

Whitish. Apo. reddish; sp. 12–18 μ × 5–6 μ. Calcareous. R.	8. B. Arnoldi Kremp.
Sp. 16–23 μ × 6–7 μ. R.	Var. luteella A. L. Sm.
Green, cracked. Apo. pale-yellow; sp. 8–12 μ × 3–5 μ. R.	10. B. littorella A. L. Sm.
††Apothecia dark-coloured.	
§Hypothecium colourless or pale.	
K + y. Dull-greenish-white. Sp. mod. F.	33. B. biformigera A. L. Sm.
Brownish or greyish. Paraph. dark-capitate; sp. small. C.	28. B. lenticularis Koerb.
Shining, green. Sp. mod. R.	38. B. subviridis A. L. Sm.
§§Hypothecium dark-coloured.	
K + y. Sordid-yellow, columnar. Sp. mod. R.	32. B. columnatula A. L. Sm.
Kf + y. Thin, wrinkled greyish. Sp. small. R.	37. B. obturbans A. L. Sm.
Thin, cracked, greyish-green. Hym. bluish; sp. 8–16 μ × 3–4 μ. R.	30. B. chalybeia subsp. chloroscotina A. L. Sm.
**Thallus dark-coloured.	
†Apothecia light-coloured.	
Dark-grey. Apo. minute, pale-reddish, marginate; spores 18–23 μ × 7–9 μ. R.	7. B. jejuna A. L. Sm.
††Apothecia dark-brown or black, small.	
§Hypothecium colourless.	
Granulose-areolate, dark-grey. Apo. convex; sp. small. S.	22. B. synothea subsp. subnigrata A. L. Sm.
Thin, subgranulate, blackish. Apo. plane; sp. mod. R.	29. B. rhypodiza A. L. Sm.
Thin, granular, tawny-brown. Apo. plane; sp. small. R.	31. B. dolosa A. L. Sm.
Thin, cracked, dark-grey. Apo. plane then convex; sp. mod. R.	36. B. confusior A. L. Sm.
§§Hypothecium dark-coloured.	
Dark-grey or black. Apo. plane; sp. 7–10 μ × 3–4 μ. C.	30. B. chalybeia Mudd.
Hymenium K + purple. In streams. R.	Subsp. chloroscotina A. L. Sm.
Dull-ochraceous, cracked. Apo. plane; sp. small. R.	34. B. lutosa Jatta.
Dark-brown. Apo. convex; sp. 10–14 μ × 3–4 μ. R.	35. B. contristans A. L. Sm.

D. Growing on other lichens. Apothecia small.

On *Lecanora calcarea*.	
Apo. plane then convex, black; sp. 9–14 μ × 4–5 μ. R.	39. B. supernula A. L. Sm.
Apo. often aggregate, black; sp. 10–18 μ × 4–5 μ. F.	40. B. episema A. L. Sm.
On *Lecanora subcarnea*.	
Apo. plane then convex, black; sp. minute. R.	41. B. cristata A. L. Sm.

On *Stereocaulon* squamules.
Apo. plane then convex, black or pale; 42. B. stereocaulorum
sp. 13–19 μ × 4–6 μ. R. A. L. Sm.
On *Peltigera* and *Solorina*.
Apo. becoming convex and blackish; 43. B. epiblastematica
sp. 12–15 μ × 5–7 μ. R. A. L. Sm.

76. **BILIMBIA** De Not. Thallus minutely squamulose or variously crustaceous, sometimes obsolete. Algal cells Protococcaceæ. Apothecia light-coloured (biatorine) or dark and carbonaceous (lecideine); spores usually 8 in the ascus, oblong-ellipsoid or fusiform, 2- or more septate (mostly 3-septate), colourless.

The genus is allied to *Biatorina*, but differs in the septation of the spores which are mostly 3-septate, any variation is noted and spore sizes are given throughout. Some species of *Bilimbia* approach very near to those of *Bacidia*, but the spores are broader, not acicular. As the grouping here also is artificial the numbers are not consecutive.

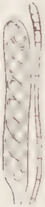


FIG. 50.—*Biatorina pulverea* Mudd. Ascus with spores and paraphysis × 250.

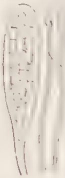


FIG. 51.—*Bilimbia sabuletorum* Branth. & Rostr. Ascus with spores and paraphyses × 300.

A. On bare or mossy trees or wood.
*Apothecia light-coloured; hypothecium pale.
Granular, greyish or greenish. Sp. 15–21 μ × 5–7 μ.......................... 9. B. sphæroides Koerb.
Sp. 18–24 μ × 5–7 μ. R. .... Var. alabastrites A. L. Sm.
Granulose, greyish. Apo. flesh-coloured or dark; sp. 14–25 μ × 4–6 μ. R. ... 10. B. Nægelii Anzi.
**Apothecia dark, or pale then dark.
†Hypothecium pale.
Leprose, greenish. Sp. 12–20 μ × 3–4 μ. Pales. R. .... 18. B. Nitschkeana Lahm.
Granulose, white or dark-grey. Sp. 3–7-sept., 18–34 μ × 6–8 μ. F. 19. B. sabuletorum Br. & Rostr.
Sp. up to 9-sept., 28–50 μ × 7–11 μ. R. .... Subsp. lubens A. L. Sm.
Thin, dull-green. Sp. straight or curved, 22–38 μ × 3–5 μ. R. .... 29. B. chlorococca Græwe.

††Hypothecium dark.

K + y, C + y. Minute sq., pale or olive. Sp. 11–15 μ × 4–5 μ. Firs or pales. F. 1. B. caradocensis A. L. Sm.

K + y, C + reddish. Thin, pale. Sp. 3–7-sept., straight or curved, 16–32 μ × 5–7 μ. .... 21. B. lignaria Massal.

Thallus darker .... f. nigrata A. L. Sm.

Thin, dull-green or blackish. Sp. 14–22 μ × 4–6 μ. On wood. R. . . 22. B. melæna Arn.

Thin, whitish. Ep. pale; sp. small. Holly stumps. R. 30. B. subturgidula A. L. Sm.

Thin, greenish. Ep. dark; sp. small. Holly stumps. R. .... 31. B. deducta A. L. Sm.

B. On mortar, soil or mossy soil.

*Apothecia light-coloured. (Th. crustaceous.)

Granulose, grey or greenish. Sp. 15–21 μ × 5–7 μ. On soil. S. ...... 9. B. sphæroides Koerb.

**Apothecia dark. Hypothecium dark (pale in *B. squalida* and *B. subviridescens*).

†Thallus squamulose.

Thickish, crowded, pale. Sp. 13–25 μ × 4–6 μ. Mortar and soil. C. ...... 2. B. aromatica Jatta.

Thickish, grey. Sp. 14–24 μ × 3–6 μ. Sandy soil. F. .... 6. B. sabulosa Massal.

Mossy soil .... Var. montana A. L. Sm.

Crowded areolate groups, brown. Sp. 15–18 μ × 4–5 μ. Rocky soil. F. .... 4. B. squamulosa A. L. Sm.

Crowded, brown. Sp. 18–36 μ × 4–5 μ. Mosses and lime soil. R. .... 7. B. squalida Jatta.

††Thallus crustaceous.

K + y, C + red. Granulose, whitish. Sp. 3–7-sept., 16–32 μ × 5–7 μ. Mossy soil. C. .... 21. B. lignaria Massal.

Areolate, turgid, white. Sp. 2–4 sept., 15–16 μ × 3–5 μ. Mortar. R. ...... 8. B. candida A. L. Sm.

Thin, grey. Apo. margin crenulate; sp. 17–21 μ × 6–7 μ. Mosses. R. 24. B. rhexoblephara A. L. Sm.

Thin, dull-green. Sp. 11–18 μ × 4–6 μ. Mossy soil. R. 20. B. subviridescens A. L. Sm.

Leprose, dark. Sp. 14–22 μ × 4–6 μ. Turfy ground. F. .... 22. B. melæna Arn.

C. On bare or mossy rocks or stones.

*Thallus squamulose; squamules various.

†Apothecia dark. Hypothecium dark (pale in *B. violacea*).

K + y. Small, white. Sp. 3–5-sept. 24–34 μ × 5–8 μ. R. 26. B. leucophæopsis A. L. Sm.

Sq. darker, white at edges ....26a. B. cambrica Wheld.

Thick, dark. Sp. 15 – 22 μ × 4 μ. Hills. R. .... 3. B. carbonacea Jatta.

Small, brownish. Apo. innate; sp. 15–18 μ × 4–5 μ. F. .... 4. B. squamulosa A. L. Sm.

Subgranulose. Apo. pale-grey; sp. 14–17 μ × 5–7 μ. Maritime. R. ... 27. B. violacea Th. Fr.

**Thallus crustaceous.

†Apothecia pale (dark in *B. violacea*). Hypothecium pale.

Kf + y. Thin, greenish. Apo. reddish; sp. 11–18 μ × 3 μ. R. .... 15. B. herbidula A. L. Sm.

Thin, greenish. Apo. innate; sp. 19–32 μ × 6–8 μ. Alpine. R. ...... 11. B. metamorphea Oliv.

Thin, whitish. Apo. pinkish-yellow; sp. 16-18 μ × 5 μ. R. .... 12. B. hyalinescens Boist.

Granulose, grey; sp. 5–9-sept., 28–50 μ × 7–11 μ. R. 19. B. sabuletorum subsp. lubens A. L. Sm.

Finely granular, greenish. Apo. light to dark-brown; sp. 15–30 μ × 2–4 μ. R. .... 13. B. cuprea Massal.

Areolate whitish. Apo. pinkish; sp. 10–18 μ × 4–6 μ. R. 14. B. albidocarnea. A. L. Sm.

Sp. narrower, 14–21 μ × 2 μ. Cal. R. Var. alborubella A. L. Sm.

Apo. violet within; sp. 14–20 μ × 2–3 μ. Cal. R. Subsp. chlorotropoides A. L. Sm.

Continuous, greenish. Apo. yellowish, pubescent; sp. 23-27 μ × 3–4 μ. R. 16. B. byssoboliza A. L. Sm.

Thinly subsquamulose. Apo. greyish; sp. 14–17 μ × 5–7 μ. Maritime. R. 27. B. violacea Th. Fr.

††Apothecia dark-coloured, or pale then dark.

§Hypothecium colourless or pale.

Thin, wrinkled, greenish. Apo. grey; sp. 12–18 μ × 6 μ. R. 17. B. hemipolioides A. L. Sm.

Granulose, greyish; sp. 3–7-sept., 18–34 μ × 6–8 μ. F. 19. B. sabuletorum Br. & Rostr.

Sp. 3-sept., acute at one end, 11–18 μ × 4–5 μ. R. .... Var. simplicior A. L. Sm.

Apo. brownish within; sp. 3-sept., 15–30 μ × 5–8 μ. R. .... Var. obscurata A. L. Sm.

Subgranulose, dark; sp. 14–22 μ × 4–5 μ. On moss and stones. S. 20. B. subviridescens Var. triseptata A. L. Sm.

§§Hypothecium generally dark (brownish in *B. trachona*).

Kf + y, Cf + red. Granulose, whitish; sp. 3 – 7-sept., 16 – 32 μ × 5–7 μ. Stones. R. ... . 21. B. lignaria Massal.

Darker or obsolete; sp. 30–40 μ × 7 μ. Alpine. R. .... f. nigrata A. L. Sm.

K + y. Thin, greyish-green. Apo. white - marginate; sp. 10–19 μ × 4–6 μ. R. .... 23. B. leucoblephara Arn.

Subareolate, brownish; sp. 14–20 μ × 4–6 μ. Maritime. R.	5. B. mesoidea A. L. Sm.
Granulose, dull-green. Hypo. brownish; sp. 11–19 μ × 3–4 μ. Maritime. R.	28. B. trachona Arn.

77. **BACIDIA** De Not.—Thallus minutely squamulose or mostly thinly crustaceous. Algal cells Protococcaceæ. Apothecia pale-coloured or dark, rarely carbonaceous, moderate or rather small (less than 1 mm. in diam.), sessile or adnate and plane or convex; spores usually 8 in the ascus, elongate-acicular, straight or more or less curved, pluriseptate, colourless.

Differing from the previous genera in the acicular form and the septation of the spores; they are generally many-celled up to 16 cells or more, though in early stages the septation may be undeveloped or indistinct; they are pluriseptate unless otherwise indicated. In several species they are spirally coiled, and in *B. ascaridiella* there may be 8, 16 or 32 in the ascus. The thallus is crustaceous (squamulose in *B. pulvinata*).

A. Growing on bare or mossy trees, rarely on pales.

*Apothecia light-coloured; hypothecium colourless or pale.	
Kf + y. Leprose, greyish. Sp. 45–90 μ × 3–5 μ. Chiefly elms. C.	4. B. luteola Mudd.
Granulose, greyish. Sp. 68–98 μ × 5 μ. R.	3. B. roseola De Not.
Leprose, greenish. Sp. 27–40 μ × 2 μ. C.	6. B. phacodes Koerb.
Scurfy, yellowish. Sp. about 45 μ × 2 μ. S.	9. B. effusa Arn.
**Apothecia pale then dark; hypothecium colourless or pale.	
Granulose, greyish. Sp. 50–80 μ × 3–5 μ. R.	5. B. acerina Arn.
Evanescent. Sp. 29–35 μ × 2–4 μ, often curved. *Salix*. R.	18a. B. salicicola Wheld. & Trav.
Thin, dark or whitish. Hypo. brownish; sp. 60–75 μ × 3–5 μ. R.	7. B. fuscorubella Arn.
***Apothecia dark-coloured (dark-red or -brown to black).	
†Hypothecium colourless or pale.	
Granulose, grey. Epi. brown; sp. 45–55 μ × 2–3 μ. C.	18. B. arceutina Br. & Rostr.
Evanescent. Sp. often curved, 35–45 μ × 1–2 μ. *Salix* leaves. R.	18b. B. epiphylla Wheld. & Trav.
Thinly granular, whitish. Epi. K + violet; sp. blunt at ends, 16–32 μ × 2–3 μ. S.	19. B. Beckhausii Koerb.
Granulose, greenish. Epithecium K + violet; sp. 40–70 μ × 3–5 μ. C.	24. B. atrogrisea Arn.
Leprose, dark. Sp. spirally curved, 20–40 μ × 3–4 μ. Pales. R.	25. B. umbrina Br. & Rostr.
Effuse, greenish. Sp. attenuate above, often curved, 36–40 μ × 2–3 μ. Wood. R.	15. B. inundata Koerb.

††Hypothecium dark-coloured.

Th. effuse, greenish. Apo. K + violet; sp. 15–29 μ × 2–3 μ. S. .... 20. B. incompta Anzi.

Th. granular, whitish. Sp. 22–44 μ × 3–4 μ (not recorded in Britain) ...... 22. B. atrosanguinea Th. Fr.

B. On bare or mossy soil. (Thallus squamulose in *B. pulvinata*.)

Apothecia dark-coloured (at first pale in *B. latebricola*).

†Hypothecium colourless or pale.

Granulose, greenish-yellow. Sp. 26–43 μ × 1–2 μ. Dunes. R. 17a. B. latebricola Wheld. & Trav.

Areolate, grey. Sp. 3-sept., 18–25 μ × 2–4 μ. Clay. R. 23. B. circumpallens A. L. Sm.

††Hypothecium dark-coloured.

Squam.-pulvinate, whitish. Sp. 20–38 μ × 3–5 μ. Turf. R. .... 1. B. pulvinata Mudd.

Thin, grey. Paraph. black above; sp. 27–40 μ × 3 μ. Mossy soil. C. ..... 21. B. muscorum Mudd.

Effuse, bright yellow-green. Sp. 36–100 μ × 3–4 μ. Uplands. F. .... 27. B. flavorubescens Anzi.

Obsolete. Sp. fewer in the ascus. Sandy soil, or on *Bæomyces rufus*............ Var arenicola A. L. Sm.

Granulose, brownish. Sp. 23–40 μ × 3–4 μ. Very rare. 22. B. atrosanguinea var. oribata A. L. Sm.

C. On bare or mossy rocks.

*Apothecia light-coloured (partly dark in *B. carneoalbens*.)

K + y, C + red. Granulose, greenish. Sp. 23–27 μ × 3–4 μ. Maritime. R. 13. B. carneoalbens A. L. Sm.

Leprose, greenish. Sp. 12–21 μ × 2–4 μ. R. .... 10. B. prasinoides Oliv.

Leprose, greenish. Sp. 25–40 μ × 3–4 μ. R. 11. B. carneoglauca A. L. Sm.

Leprose, greenish. Sp. often bent, 20–35 μ × 1 μ. Rocks in streams. R. 12. B. chloroticula A. L. Sm.

Granular, brownish-green. Sp. 32–44 μ × 1 μ. Maritime. R. .... 14. B. scopulicola A. L. Sm.

**Apothecia dark-coloured (sometimes reddish in *B. herbarum*, pale to dark in *B. inundata*).

†Hypothecium colourless or pale (brownish in *B. herbarum* and *B. egenula*).

K + y. Wrinkled, black. Sp. 30–35 μ × 1–2 μ. Maritime. R. .... 16. B. caligans A. L. Sm.

Kf + y. Granulose, grey. Sp. 20–38 μ × 2 μ. Uplands. R. .... 17. B. egenula Th. Fr.

Granulose, grey or whitish. Sp. straight or curved, 38–56 μ × 1–2 μ. R. ...... 8. B. herbarum Arn.

Granulose, areolate, greenish. Sp. 34–40 μ × 2–3 μ. Moist places. F. ... 15. B. inundata Koerb.

Effuse, grey. Sp. 45–70 μ × 2–3 μ. Moss, maritime. R. 18. B. arceutina var. hypnæa A. L. Sm.
Leprose, dark. Sp. spirally curved, 20–40 μ × 3–4 μ. C. .... 25. B. umbrina Br. & Rostr.
Areolate, whitish. Sp. 8–32 in ascus, spirally curved, 25–30 μ × 2 μ. Cal. R. .... 26. B. ascaridiella A. L. Sm.
††Hypothecium dark.
Granulose, whitish. Sp. straight or curved, 27–40 μ × 2–3 μ. Mossy boulders. F. .... 21. B. muscorum Mudd.

78. **BUELLIA** De Not.—Thallus squamulose (radiate-plicate), crustaceous, or wanting. Algal cells Protococcaceæ. Apothecia dark-coloured and carbonaceous, immarginate, or with a proper margin only; asci usually 8-spored; spores ellipsoid or oblong, usually 1-septate, dark-brown, or rarely brownish, sometimes with an epispore (halonate).

The genus is nearly related to *Rhizocarpon*. The apothecia are generally moderate in size, ·5–1 mm. in diam.; the paraphyses are dark at the apices; the spores bear some resemblance to those of *Rinodina*, but they have a thinner septum and no connecting channel, usually they are dark-brown or brownish; in a few species (*B. colludens*, *B. confervoides* etc.) they remain colourless for a long time. Spore sizes are indicated as in *Lecidea*. The thallus is squamulose only in *B. canescens*, which forms orbiculate, sorediate white patches on trees or rocks, about 3 or more cm. across and generally effigurate at the circumference. Species parasitic on other lichens are frequently classified under the genus *Abrothallus*.

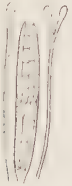


FIG. 52.—*Bacidia rubella* Massal.
Ascus with spores and paraphyses × 200.

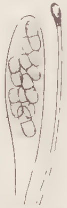


FIG. 53.—*Buellia myriocarpa* Mudd.
Ascus with spores and paraphysis × 300.

A. On trees, pales, etc.

*Thallus light. Hypothecium dark.
K + y. Squamulose, sorediate, white. Sp. mod. C. .... 1. B. canescens De Not.
K + y. Thin, aerolate, whitish. Sp. 19–30 μ × 8–14 μ. C. .... 25. B. disciformis Mudd.
Patchy, silvery-white. Sp. mod. Holly. R. .... 8. B. biloculata A. L. Sm.

Filmy, white. Sp. 2-sept., 20–22 μ × 9 μ. R.	9. B. polospora A. L. Sm.
Powdery, whitish. Apo. and sp. small. S.	11. B. Schæreri De Not.
**Thallus mostly dark.	
Granular, grey or dark. Hypo. dark-brown; sp. 9–16 μ × 4–8 μ. C.	10. B. myriocarpa Mudd.
Thin, blackish. Apo. red-brown; sp. mod. Holly. R.	12. B. præcavenda A. L. Sm.
Thin, dark-grey. Apo. black; sp. 16–22 μ × 9–12 μ. R.	26. B. lyperiza Stirt.
B. On bare or mossy soil.	
Thallus light. Hypothecium dark.	
K + y. Thin, areolate, yellow-green. Sp. 12–18 μ × 6–8 μ. S.	29. B. scabrosa Koerb.
K + y. Granular whitish. Alpine. R.	26. B. disciformis var. insignis A. L. Sm.
Orbicular whitish. Apo. pruinose; sp. 16–21 μ × 7–9 μ. R.	2. B. epigæa Tuck.
Orbicular, sulphur-yellow. Sp. mod. Alpine. R.	31. B. pulchella Tuck.
C. On rocks mainly siliceous.	
*Hypothecium colourless to brownish.	
K + y. Thin tartareous, grey-brown. Sp. 19–21 μ × 10–11 μ. R.	6. B. discolor Koerb.
Thin tartareous, whitish. Sp. mod. Chiefly Cal. R.	3. B. alocizoides A. L. Sm.
Thin, areolate, grey, on black hypothallus. Sp. mod. F.	4. B. spuria Koerb.
Thin, areolate yellowish. Sp. mod. R.	5. B. occulta Koerb.
**Hypothecium dark (brown or black-brown).	
†Thallus variously light-coloured.	
Kf + y. Thin, areolate. Sp. 15 μ × 7 μ. Mountains. R.	19. B. excelsa A. L. Sm.
Kf + y. Thin, areolate. Epi. K + p; sp. 22–27 μ × 8–13 μ. R.	33. B. deludens A. L. Sm.
K + y. Squamulose, sorediate. Sp. mod. C.	1. B. canescens De Not.
K + y. Thin, areolate, grey. Sp. mod. often curved. R.	21. B. leptoclinoides Stein.
K + y. Thin, areolate, suborbicular. Sp. small. C.	22. B. stellulata Mudd.
K + y. Areolate, greyish. Sp. 18–22 μ × 9–11 μ. R.	25. B. disciformis var. saxicola Oliv.
Sp. Sometimes 3-sept. R.	Var. triphragmia Boist.
K + y then red. Areolate, grey or brown on black hypothallus. Sp. mod. F.	13. B. æthalea Th. Fr.
K + y then red. Filmy, areolate, grey. Apo. minute; sp. mod. R.	23. B. impressula A. L. Sm.
K + y then red. Thick, tartareous, grey. Apo. larger; sp. mod. R.	17. B. ryssolea A. L. Sm.

K + y then red. Thickish, areolate, dull-yellow. Apo. pruinose. Sp. mod. F.	24. B. subdisciformis Jatta.
K + y then red. Thickish, areolate, bright-yellow. Sp. 18–28 μ × 10–15 μ. S.	30. B. alpicola Kremp.
K + y, C + red. Thin, areolate, dull-yellow. Sp. mod. R.	18. B. saxorum Mudd.
C + red. Thin, areolate, yellow-green. Sp. mod. F.	15. B. verruculosa Mudd.
Determinate, warted-areolate	Subsp. præponens A. L. Sm.
Thin, areolate, grey, on black hypothallus. Sp. 8–15 μ × 4–7 μ. S.	4. B. spuria Koerb.
Thin granular, greenish. Sp. 9–16 μ × 4–8 μ. F.	10. B. myriocarpa Mudd.
Thickish, unequal, yellowish or grey. Sp. small to mod. R.	16. B. saxatilis Koerb.
Thin unequal, whitish. Sp. 11–14 μ × 4–6 μ. R.	14. B. succedens A. L. Sm.
Gradular, whitish. Sp. 11–16 μ × 6–8 μ. R.	20. B. leptocline var. Mougeotii Th. Fr.
Thin, areolate, whitish. Sp. 22–27 μ × 8–13 μ (epispore). R.	33. B. deludens A. L. Sm.
Areolate, reddish-brown. Sp. 18–19 μ × 7–14 μ. F.	32. B. colludens Tuck.
Areolate, dull-white. Sp. 21–30 μ × 8–14 μ. R.	34. B. confervoides Kremp.
††Thallus dark (with black hypothallus).	
K + y then red. Th. thick, areolate. Apo. minute, convex. Sp. 11–17 μ × 6–10 μ. R.	28. B. atrata Mudd.
K(C) + y. Thick, areolate; sp. with epispore, 26–36 μ × 12–18 μ. R.	35. B. badioatra Koerb.
Warted-granular, thin. Apo. plane; sp. 12–17 μ × 8-9 μ. R.	27. B. coniops Th. Fr.
Effuse, areolate, brownish-grey. Sp. brownish, 18–29 μ × 7–14 μ. F.	32. B. colludens Tuck.
Tartareous, areolate. Sp. brownish, with epispore, 25–36 μ × 12–17 μ. R.	36. B. atroalba Th. Fr.
D. Parasitic on other lichens (sometimes classified as fungi).	
Parmeliaceæ and Stictaceæ.	
Apo. minute; sp. 17-21 μ × 7–8 μ. C.	37. B. parmeliarum Oliv.
Bæomyces rufus.	
Apo. small; sp. 8-10 μ × 3-5 μ. R.	38. B. particularis A. L. Sm.
Pertusaria Wulfenii.	
Apo. minute; sp. 19-23 μ × 14-16 μ. S.	39. B. advenula A. L. Sm.

79. **LECIOGRAPHA** Massal.—Thallus none. Apothecia parasitic on the thallus of other lichens, immersed then superficial, discoid, black and carbonaceous; hypothecium dark-coloured; spores 8, oblong-ellipsoid or -fusiform, 3-septate, brown.

Frequently included among fungi (Patellariaceæ). The apothecia are generally round, but may become elongate in time. The genus is distinguished by the 4-celled brown spores. The apothecia are rather small.

Hypo. red-brown; sp. mod. *Lecanora parella* and *Pertusaria pertusa*. C.	1. L. parasitica Mudd.
Hypo. blackish; sp. large. *Lecanora sordida*. R.	2. L. glaucomaria A. L. Sm.
Hypo. brown; sp. 20–35 μ × 3–4 μ. *Parmeliella plumbea*. R.	3. L. plumbina Anzi.

80. **RHIZOCARPON** Ramond. Thallus crustaceous usually with a dark hypothallus. Algal cells Protococcaceæ. Apothecia usually black and carbonaceous, immarginate or with a proper margin only; asci 8- or fewer-spored; spores ellipsoid or oblong, usually large, septate and muriform, colourless or brown, usually with a hyaline mucilaginous epispore (halonate).

Rhizocarpon species are mostly saxicolous. *Rh. geographicum* is to be found on uplands and mountains over the whole globe. The dark hypothallus, usually well developed and visible between the areolæ or as dark lines crossing and limiting the thallus, is absent in *Rh. alboatrum* and *Rh. calcareum*. The apothecia are usually small in size, carbonaceous and adnate or plane (lighter coloured and softer in *Rh. perlutum*), with dark hypothecium and dark tips to the paraphyses. The medulla stains blue with iodine in *Rh. Œderi* and *Rh. geographicum*. The spores are colourless at first, then generally brownish or very dark. They are more or less muriform except in *Rh. Œderi*, where they are 3-septate.

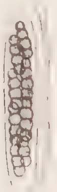


FIG. 54.—*Leciographa parasitica* Massal.
Ascus with spores and paraphysis × 500.

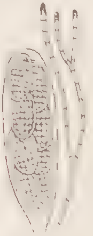


FIG. 55.—*Rhizocarpon obscuratum* Massal.
Ascus with spores and paraphysis × 250.

A. On trees or on wood. Thallus white or grey. Spores 3-septate and muriform.

Areolate. Apo. sometimes pruinose; sp. brown, not halonate, 16–20 μ × 7–9 μ. C.	3. Rh. alboatrum Th. Fr.
Warted. Apo. crowded, pruinose; sp. brown, 13–20 μ × 8–10 μ. R.	5. Rh. soreumidium A. L. Sm.

B. On rocks.
*Thallus rusty-red.
Med. I + blue. Granular-areolate. Sp. brownish, 3-sept., 18–24 μ × 8–11 μ. F. 2. Rh. Œderi Koerb.
Areolate, grey, sometimes rusty-red. F. 13. Rh. obscuratum Massal.
**Thallus yellow-green.
Med. I + blue. Thin, smooth, areolate, with intersecting lines. Sp. dark, 24–40 μ × 11–18 μ. C. .... 6. Rh. geographicum DC.
Granular areolate. Sp. dark, 18–26 μ × 9–11 μ. S. .... 7. Rh. viridiatrum Koerb.
***Thallus light-coloured. Apothecia more or less pruinose.
K + y, then red. Whitish, areolate. Sp. light to dark-brown, 15–30 μ × 10–12 μ. R. .... 4. Rh. chlorophæum A. L. Sm.
Cracked, yellowish-white. Apo. large, rusty-brown; sp. colourless, 30–42 μ × 13–16 μ. R. .... 1. Rh. perlutum Zahlbr.
Orbicular, areolate in centre, white. Sp. brownish, 22–30 μ × 12–18 μ. C. ..... 8. Rh. calcareum Th. Fr.
Orbicular, areolate. Apo. in lines; sp. brownish, 25–44 μ × 11–17 μ. C. ..... 9. Rh. petræum Massal.
Effuse or determinate. Apo. pruinose. C. 3. Rh. alboatrum var. epipolium A. L. Sm.
****Thallus indistinct or almost obsolete.
Pulverulent, yellowish or grey. Apo. minute, black; sp. brownish, 18–22 μ × 8–10 μ. R. .... 3a. Rh. lotum Stizenb.
Effuse, thin. Apo. small, black; sp. brownish, 15–16 μ × 6–7 μ. R. .... 11. Rh. postumum Th. Fr.
*****Thallus brown or greyish, mostly in small areolæ.
Kf + y. Plane, areolate, grey or brown. Sp. brownish, 24–50 μ × 12–18 μ. F. 13. Rh. obscuratum Massal.
K + y, C + y. Minutely warted, whitish. Apo. rather large; sp. (4–8) brownish, 27–30 μ × 9–10 μ. R. .... 14. Rh. plicatilis A. L. Sm.
C + y. Warted-areolate, grey or brown. Apo. small; sp. (1–2) blackish, 40–57 μ × 23–32 μ. R. .... 15. Rh. geminatum Koerb.
Grey or brown, with fimbriate hypothallus. Sp. becoming dark, 20–38 μ × 10–17 μ. C. .... 10. Rh. confervoides DC.
Grey or brown. Apo. small, purplish-brown within; sp. pale-olive, 24–32 μ × 12–15 μ. R. .... 12. Rh. distinctum Th. Fr.

81. **BOMBYLIOSPORA** De Not. Thallus crustaceous. Algal cells Protococcaceæ. Apothecia light- or dark-coloured, with a proper margin only; ascus 1-(8)-spored; spores large, elongate-ellipsoid, colourless or faintly coloured, multi-septate.

K + y. Thallus thickish, light-coloured. Apo.
large; sp. 7–10-septate, 70–160 μ × 25–35 μ.
Trees and rocks. R. .... B. incana A. L. Sm.

82. **LOPADIUM** Koerb.—Thallus crustaceous. Algal cells Protococcaceæ. Apothecia light- or dark-coloured, with a proper margin only; ascus 1-(4–8)-spored; spores large, colourless or brownish, muriform.

The genus differs from *Rhizocarpon* in the often more biatorine apothecia. The species belong mostly to warm countries, only a few are found in temperate regions. British species grow on mosses covering rocks or soil in hilly districts.

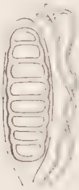


FIG. 56.—*Bombyliospora incana* A. L. Sm.
Ascus with spore and paraphyses × 200.

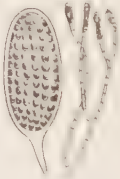


FIG. 57.—*Lopadium pezizoideum* Koerb.
Ascus with spore and paraphysis × 250.

*Spores 1 in the ascus.
Thallus dark. Apo. black; hypo. dark;
sp. 65–110 μ × 30–46 μ. S. .... 1. L. pezizoideum Koerb.
K + y. Thallus whitish. Apo. dull-orange;
hypo. colourless; sp. 48–100 μ × 24–
55 μ. S. .... 2. L. fuscoluteum Mudd.
**Spores 8 in the ascus.
Thallus thickish, grey. Apo. black; sp.
brownish, 22–40 μ × 10–18 μ. R. .... 3. L. fecundum Th. Fr.

Subseries III. *GRAPHIDINEÆ.*

Thallus crustaceous or fruticose. Algal cells Trentepohliaceæ (rarely Palmellaceæ). Apothecia roundish or irregular (*ardellæ*) or linear (*lirellæ*), immarginate or with a proper margin only.

The Graphidineæ are distinguished by the almost universal presence of "chrysogonidia" (Trentepohliaceæ) in the thallus and by the form and structure of the apothecia. The structure of the thallus does not differ materially from that of the Cyclocarpineæ: in one family, Roccellaceæ, it attains to considerable fruticose dimensions. Other members of the subseries are crustaceous and, in many of those that grow on trees, the thallus is developed below the bark (hypophlœodal) and appears as a dark or light stain on the surface.

The algæ may retain this filamentous form or they may be broken up within the thallus into short lengths or separate cells.

Apothecia growing singly.
  Thallus corticate on one or both surfaces.
    Thallus crustaceous.......................... XX. DIRINACEÆ.
    Thallus fruticose, strap-shaped .... XXI. ROCCELLACEÆ.
  Thallus non-corticate.
Apothecia roundish or irregular.
  With proper margin .... XXII. LECANACTACEÆ.
  Immarginate.. XXIII. ARTHONIACEÆ.
Apothecia elongate .... XXIV. GRAPHIDACEÆ.
Apothecia compound in a stroma or pseudostroma; immersed, roundish or elongate...... XXV. CHIODECTONACEÆ.

FAMILY XX. DIRINACEÆ.

Thallus crustaceous, attached by hyphæ, corticate on the upper surface, the cortex of closely packed upright hyphal branches (fastigiate). Algal cells *Trentepohlia*. Apothecia roundish or somewhat elongate, generally with proper and thalline margins; hypothecium and disc dark-coloured; spores elongate, septate. Spermogones with simple sterigmata and acicular, bent acrogenous spermatia.

A small family represented in the British Isles by a single genus and species. It is classified under Graphidineæ on account both of thalline and apothecial characters and is nearly allied to Roccellaceæ.

83. **DIRINA** Fr.—Thallus continuous or cracked, greyish-white, farinose and soft. Apothecia white pruinose; spores colourless.

Spores fusiform, slightly bent, 3-septate, ca. $22\ \mu \times 5\ \mu$ ... D. repanda Nyl.

FAMILY XXI. ROCCELLACEÆ.

Thallus mostly fruticose, of strap-shaped or rounded branching fronds, attached to the substratum by a basal sheath, corticate, with a central rather loose medulla of hyphæ. Algal cells *Trentepohlia*. Apothecia roundish or somewhat elongate, usually with proper and thalline margins; spores 8 in the ascus, colourless or rarely brownish, elongate, septate. Spermogones with simple or sparingly branched sterigmata and straight or curved acrogenous spermatia.

There is only one genus, *Roccella*, represented in Europe. The whole genus is mainly confined to the sea coasts of warm countries.

Thallus fruticose with basal sheath .... 84. **Roccella** DC.

84. **ROCCELLA** DC.—Thallus of cylindrical or strap-shaped fronds, simple or branched, greenish- or bluish-grey, mostly sorediate; cortex of closely packed hyphal branches disposed at right angles to the surface (fastigiate); medullary hyphæ more or less parallel to the long axis;

gonidia within the cortex. Apothecia lateral on the fronds, mostly discoid, with a proper margin, and with or without a thalline margin; hypothecium thick, black; paraphyses branched; spores elongate-oblong or -fusiform, mostly 3-septate, colourless.

The species of *Roccella* yield in more or less abundance a purple dye, the "orseille" or orchil of commerce. *R. tinctoria*, which is not British, is the best known and was one of the earliest recorded lichens. There are two British species which grow on maritime rocks chiefly of the Southern coasts.

Fronds short, much branched, subcylindrical ... 1. R. fucoides Wain.
Fronds long, compressed, branched, often proliferate.. 2. R. fuciformis DC.

FAMILY XXII. LECANACTACEÆ.

Thallus crustaceous. Algal cells *Trentepohlia*. Apothecia roundish or oblong, immersed or sessile, immarginate or with a proper margin only; paraphyses branched; spores colourless, elongate, septate.

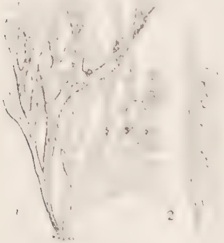


FIG. 58.—*Roccella fuciformis* DC.
1. Plant on rock, reduced ca. ⅓. 2. Ascus with spores and paraphysis × 250.

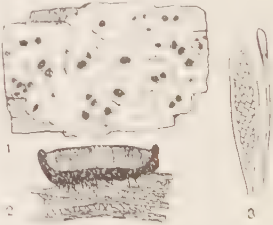


FIG. 59.—*Lecanactis premnea* Wedd.
1. Plant on bark. 2. Vertical section of apothecium × 18. 3. Ascus with spores and paraphysis × 250.

The family is related to Lecideaceæ by the form of the fruit, to Graphidaceæ by the internal structure of the fruit and by the algal symbiont. The genera occur more frequently in warm countries.

Apothecia with a proper margin .... 85. **Lecanactis.**
Apothecia immarginate .... 86. **Platygrapha.**

85. **LECANACTIS** Eschw. Thallus crustaceous. Apothecia black, roundish, with a carbonaceous proper margin; hypothecium carbonaceous, black; paraphyses more or less confluent, ascus clavate, 8-spored; spores fusiform or acicular, 3–5-septate, colourless.

The thallus of the British species is effuse, rather thin, mostly furfuraceous, and light- or dark-grey. The spores resemble those of *Bilimbia*.

Apothecia naked or dark-greenish-pruinose.
  Apo. with thin flexuose margin ; sp. 5-sept., 18–25 μ × 5–7 μ. Trees. C. .... 1. L. premnea Wedd.
    Rocks. R. .... Var. saxicola A. L. Sm.
Apothecia greyish or whitish-pruinose.
  Apo. rather large, with thickish margin ; sp. 3-sept., 35–40 μ × 4–6 μ. On trees ; frequent .... 2. L. abietina Koerb.
    Th. thicker. Mossy rocks. R. .... Var. incrustans Oliv.
  Apo. small, thin margin ; sp. 1–5-sept., 16–21 μ × 3–4 μ. Trees. R. .... 3. L. illecebrosa Fr.
  Th. Kf + y, C + o. Apo. small, thin margin ; sp. 3-sept., 23–32 μ × 5–6 μ. Rocks. R. .... 4. L. Dilleniana Koerb.
  Th. K + y, C + red. Apo. small, thin margin ; sp. 3-sept., 15–23 μ × 3 μ. Rocks. R. .... 5. L. delimis A. L. Sm.

86. **PLATYGRAPHA** Nyl.—Thallus scanty or evanescent. Apothecia blackish, roundish, oblong or irregular, immarginate, but with a spurious thalline margin ; spores 8 in the ascus, fusiform, septate, colourless ; paraphyses slender, more or less discrete.

The genus is almost wholly confined to warm countries. The British species grow on trees.

Thallus whitish.
  Subleprose. Apo. various ; sp. 3-sept., 30–42 μ × 3–4 μ. R. .... 1. P. periclea Nyl.
  Warted, areolate. Apo. various ; sp. 3-sept., 24–34 μ × 3–4 μ. R. .... 2. P. rimata Nyl.

FAMILY XXIII. ARTHONIACEÆ.

Thallus crustaceous, thin, often developed beneath the bark (hypophlœodal) or wanting. Algal cells *Trentepohlia* or (rarely) *Palmella*. Apothecia roundish or irregular, *ardellæ*, or elongate, *lirellæ* ; asci short, pyriform, spores 4 to 8 in the ascus, colourless or brownish, septate or muriform ; paraphyses branched above.

The family is distinguished by the flat immarginate apothecia by the short pyriform asci, and by the epithecium formed from the branching paraphyses. Species of *Arthonia* are sometimes classified as fungi.

Spores 1- many-septate .... 87. **Arthonia.**
Spores septate and muriform .... 88. **Arthothelium.**

87. **ARTHONIA** Ach.—Thallus thin or evanescent, often hypophlœodal. Algal cells *Trentepholia* or *Palmella*. Apothecia innate, immarginate, roundish or irregular, *ardellæ*, or elongate, *lirellæ*, plane or tumid ; asci pyriform or subglobose, rarely ellipsoid, thickened above ; spores elongate-ovate or clavate, 1- or pluri-septate, colourless or brownish.

The apothecia are rather small, not prominent, and very various in form. The species are classified under three sections :—

Thallus with *Trentepohlia* gonidia.	
Apothecia more or less brightly coloured or brown	§ i. Coniocarpon.
Apothecia blackish	§ ii. Euarthonia.
Thallus with *Palmella* gonidia	§ iii. Lecideopsis.

§ i. Coniocarpon A. Zahlbr.—Apothecia brightly coloured or brown, becoming darker, K + violet or purple.

The species of this section grow on the bark of trees.

Spores 1-septate.	
Dark. Apo. reddish to reddish-black; sp. 10–15 μ × 4–5 μ. C.	1. A. lurida Ach.
Apo. darker; sp. unequally divided	Var. spadicea Nyl.
Pale. Apo. vinous-red to dark; sp. 15–18 μ × 6–8 μ. F.	2. A. didyma Koerb.
Whitish. Apo. minute, reddish-black; sp. 12–15 μ × 5–6 μ. R.	3. A. atrofuscella Nyl.
Spores 3–4-septate, the upper cell largest.	
Greyish. Apo. mostly red-pruinose; sp. 4-sept., 18–26 μ × 7–9 μ. C.	4. A. gregaria Koerb.
Tinged purple. Apo. radiate. R.	Var. astroidea Mudd.
Th. and apo. deeply red-coloured. C.	Var. kermesina A. L. Sm.
Th. and apo. whitish. F.	Var. pruinata A. L. Sm.
Whitish. Apo. brown, elongate, stellate; sp. as in *A. gregaria*. R.	5. A. astroidestera Nyl.
Whitish. Apo. roundish, ochraceous-pruinose; sp. 3-sept., 15–18 μ × 7–8 μ. R.	6. A. elegans Ach.

§ ii. Euarthonia A. Zahlbr.—Apothecia blackish, K –.

In *Euarthonia* the thallus of the corticolous species is thin and more or less hypophlœodal. There are two saxicolous species with the thallus superficial and thicker.

*Spores 1-septate, wider at one end (corticolous).	
Yellowish, in patches. Apo. angular; sp. 14 μ × 5·5 μ. R.	7. A. aspersella Leight.
White. Apo. roundish or oblong; sp. 12–14 μ × 4 μ. R.	8. A. galactites Duf.
Pale spots. Apo. elongate; hym. I + blue; sp. 10–13 μ × 4–5 μ. R.	9. A. dispersa Nyl.
Greyish. Apo. elongate; hym. I + wine-red; sp. 16–21 μ × 5–9 μ. R.	10. A. excipienda Cromb.
Filmy. Apo. roundish; sp. 29 μ × 13 μ. R.	11. A. punctilliformis Leight.
**Spores 3–6-septate, upper cell longest.	
Greyish-green. Apo. roundish or stellate; sp. 3-sept., 13–15 μ × 5–6 μ. Holly. R.	12. A. aspersa Leight.
Rose-cream-coloured. Apo. roundish; sp. 3-sept., 13–16 μ × 6–7 μ. Rocks. R.	13. A. arthonioides A. L. Sm.

Greyish. Apo. radiate; sp. 2–4-sept., 17–22 μ × 5–7 μ. Rocks. R. .... 14. A. dendritica A. L. Sm.

Cream-coloured. Apo. roundish; sp. 6-sept., 21–36 μ × 9–12 μ. Holly. F. .... 15. A. ilicina Tayl.

***Spores 3–5-septate; cells equal in length (corticolous).

K + y, C + rose. Whitish or pale-yellow. Apo. pruinose; sp. 4–5-sept., 14–20 μ × 6–8 μ. F. .... 17. A. pruinata Steudel.

Greyish. Apo. radiate or stellate; sp. 3-sept., 12–20 μ × 4–6 μ. C. .... 18. A. radiata Ach.

Apo. more irregular .... Var. Swartziana Sydow.

Whitish or copper-coloured. Apo. roundish; sp. 3–4-sept., 16–24 μ × 5–8 μ. R. .... 19. A. punctiformis Ach.

Darker. F. .... Var. melantera Leight.

Dark in colour. Apo. roundish; sp. 4-sept., 14–21 μ × 6–8 μ. R. .... 20. A. insinuata Stirton.

§ iii. Lecideopsis Almq.—Algal cells Palmellaceæ, or thallus wanting. Apothecia blackish.

*Thallus present.

†Spores 1-septate.

Whitish. Apo. round or angular; sp. 9–15 μ × 3–5 μ. Trees. R. .... 21. A. patellulata Nyl.

Dark-brown. Apo. roundish; sp. 11–16 μ × 5–6 μ. Cal. F. .... 22. A. lapidicola Br. & Rostr.

††Spores 3–4-septate.

Dark-grey. Apo. roundish: sp. large, 18–22 μ × 7 μ. Maritime rocks. R. .... 23. A. paralia Nyl.

Pale-grey. Apo. minute; sp. small, 10–12 μ × 3–4 μ. Mica-schist. R. .... 24. A. myriocarpella Nyl.

**Thallus none (parasitic on other lichens). Spores often brownish.

Apo. round, convex; sp. 1–3-sept., 12–18 μ × 6–8 μ. Apothecia of *Lecanora glaucoma.* F. .... 25. A. varians Nyl.

Apo. minute, convex; sp. 1-sept., 11–13 μ × 4–5 μ. Apothecia of *Lecanora glaucoma.* R. .... 26. A. subvarians Nyl.

Apo. minute, innate; sp. 1-sept., 15 μ × 6 μ. *Rhizocarpon alboatrum.* R. 27. A. punctella Nyl.

Apo. rather large, convex; sp. 1-sept., 15–22 μ × 6–8 μ. *Peltigera* and *Solorina.* R. .... 28. A. peltigerea Th. Fr.

88. **ARTHOTHELIUM** Massal.—Thallus and apothecia somewhat similar to those of § *Euarthonia.* Spores ovate-ellipsoid or oblong, septate then muriform, colourless or brownish.

The thallus of the two British species is thin and whitish; they are both corticolous, and rather rare, having been found only in southern and western districts.

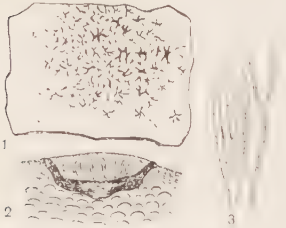


FIG. 60.—*Arthonia greguria* var. *astroidea* Mudd.
1. Plant on bark. 2. Vertical section of apothecium × 40. 3. Ascus with spores and paraphysis × 350.

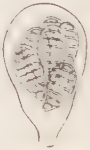


FIG. 61.—*Arthothelium spectabile* Massal.
Ascus with spores × 350.

Apo. dark, small, roundish or minutely radiate; sp. colourless, 21–27 μ × 10–15 μ.................. 1. A. dispersum Mudd.
Apo. dark, rather large, angular; sp. becoming brown, 30–36 μ × 15 μ.................................. 2. A. spectabile Massal.

FAMILY XXIV. GRAPHIDACEÆ.

Thallus crustaceous. Algal cells *Trentepohlia*, or rarely *Palmella*. Apothecia usually linear (*lirellæ*), rarely oblong or oval, simple or forked, sessile or erumpent, with a proper margin; asci elongate-clavate; spores simple or variously septate or muriform, colourless or coloured.

Distinguished by the more distinctly lirellate marginate apothecia.

Thallus with *Palmella* gonidia. Apothecia oblong or oval.
  Spores simple, colourless.
    Hymenium simple.
      Apothecia not carbonaceous...................... 89. **Xylographa.**
      Apothecia carbonaceous...................... 90. **Lithographa.**
    Hymenium compound...................... 91. **Ptychographa.**
  Spores 1-septate, brown...................... 92. **Encephalographa.**
Thallus with *Trentepohlia* gonidia. Apothecia elongate, rarely roundish.
  Spores 1 septate, colourless or brown...................... 93. **Melaspilea.**
  Spores 3-pluri-septate.
    Apothecia superficial...................... 94. **Opegrapha.**
    Apothecia innate-erumpent.
      Spores septate, colourless...................... 95. **Graphis.**
      Spores septate, brown...................... 96. **Phæographis.**
      Spores muriform, colourless...................... 97. **Graphina.**

89. **XYLOGRAPHA** Fr. Thallus developed within the substratum. Algal cells *Palmella*. Apothecia innate-erumpent, lirelliform or irregularly oblong, not carbonaceous; the disc plane or concave; hypothecium pale; paraphyses slender; spores 8 in the ascus, simple, colourless.

Differs from other Graphidaceæ in the lighter coloured apothecia. British species grow on bark or on wood of conifers; they have only been recorded from Scottish Highland localities.

Thallus whitish, thin or evanescent.

Scarcely visible. Apo. in parallel rows, with a wide disc; hypoth. colourless; sp. 11–16 μ × 5–7 μ. S. .... 1. X. parallela Fr.

Scarcely visible. Apo. scattered; hypoth. brown; sp. 12–15 μ × 7–8 μ. R. .... 2. X. laricicola Nyl.

With yellowish-green soredia. Apo. small, reddish; sp. 8–12 μ × 4–6 μ. R. .... 3. X. spilomatica Th. Fr.

90. **LITHOGRAPHA** Nyl. Thallus crustaceous, sometimes evanescent. Algal cells *Palmella*. Apothecia shortly lirellate, carbonaceous, the disc usually narrow, the margins prominent, inflexed; hypothecium usually dark-coloured; paraphyses mostly concrete; asci clavate, 8- or many-spored; spores simple, colourless.

*Spores 8 in the ascus.

Thallus light-coloured.

K + y, then red. Th. thickish, Apo. rather prominent; sp. 8–15 μ × 5–8 μ. Rocks. F. .... 1. L. tesserata Nyl.

Thickish. Apo. innate; sp. 8–9 μ × 5–6 μ. Rocks. R. .... 3. L. Andrewii Stirt.

Thin. Apo. minute, superficial; sp. 4–6 μ × 2–3 μ. Stumps. R. .... 2. L. flexella Zahlbr.

**Spores many in the ascus.

Thallus thin, light or dark.

Greyish. Apo. simple or furcate; sp. 5–8 μ × 3–4 μ. Trees. R. .... 4. L. dendrographa Nyl.

Dark. Apo. congregate; sp. 3–4 μ × 1 μ. Maritime rocks. R. .... 5. L. petræa Nyl.

91. **PTYCHOGRAPHA** Nyl. Thallus effuse. Algal cells *Palmella*. Apothecia elongate, compound, with 2–4 parallel hymenia; margins prominent, incurved; hypothecium black, carbonaceous; spores 8 in the ascus, simple, colourless.

A very rare genus, with one species, recorded only from the Scottish Highlands. It differs from *Lithographa* in the compound hymenia.

Thallus in thin greyish spots. Apo. in parallel groups; sp. 11–14 μ × 6–7 μ.

On decorticated *Pyrus Aucuparia*. R. ... P. xylographoides Nyl.

92. **ENCEPHALOGRAPHA** Massal. Thallus crustaceous. Algal cells *Palmella*. Apothecia sessile, usually in groups, elongate, roundish or angular, simple or forked, the disc usually narrow; hypothecium carbonaceous, black; spores 4–8 in the ascus, 1-septate, colourless to dark-brown.

Distinguished by the septate brown spores. The only British species is calcicolous and of rare occurrence.

Thallus thickish, tartareous, chalky-white.
Sp. 15–23 $\mu \times$ 8–12 μ. .... E. cerebrina Massal.

93. **MELASPILEA** Nyl.—Thallus thin, sometimes immersed or wanting. Algal cells *Trentepohlia*. Apothecia black and carbonaceous, with a proper margin, roundish or elongate, simple or shortly branched, the disc narrow or flattened; hypothecium colourless or dark-coloured; paraphyses slender, free; asci elongate or narrowly clavate, 8-spored; spores ellipsoid, fusiform or ovate, usually 1-septate, colourless then brown.

The thallus is thin and often scarcely visible; the apothecia are mostly minute and irregular in form; the genus is mainly distinguished from others with *Trentepohlia* gonidia by the spores. In *M. vermifera* (parasitic on *Pertusaria globulifera*) the spores are recorded as cylindrical-vermiform and spirally arranged in the ascus; in *M. Patersoni* they are acicular-cylindrical and up to 10-septate; both seem to be aberrant species.

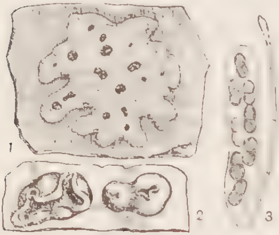


FIG. 62.—*Encephalographa cerebrina* Massal.
1. Plant on rock. 2. Portion of plant × ca. 12. 3. Ascus with spores and paraphysis × 250.

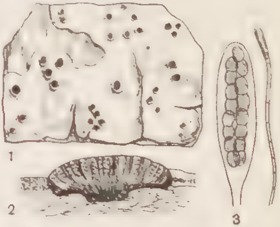


FIG. 63.—*Melaspilea proximella* Nyl.
1. Plant on bark. 2. Vertical section of thallus and apothecium × 30. 3. Ascus with spores and paraphysis × 200.

A. On trees.

*Spores colourless to pale-brown. Thallus thin, whitish.

Apo. small, numerous; sp. unequally septate, 15–16 $\mu \times$ 6–7 μ. S. .... 1. M. lentiginosa Zahlbr.

Apo. moderate; sp. 16–22 $\mu \times$ 7–10 μ. R. 5. M. amota Nyl.

Apo. with a broad disc; sp. 12–17 $\mu \times$ 4–6 μ. R. 6. M. constrictella A. L. Sm.

**Spores brown to dark-brown or blackish. Thallus thin, whitish (dull-green in *M. interjecta*).

Apo. small, numerous; sp. 20–23 $\mu \times$ 10–11 μ. R. 2. M. lentiginosula A. L. Sm.

Apo. with wrinkled disc; sp. 17–19 $\mu \times$ 7–8 μ. F. .... 7. M. proximella Nyl.

Apo. with open disc; sp. 27–32 μ × 12–16 μ. R. .... 3. M. diplasiospora Zahlbr.
Apo. roundish, plane; sp. 17–21 μ × 7–10 μ. R. .... 4. M. ochrothalamia Nyl.

B. On rocks. Thallus thin, greenish.
Apo. with narrow disc; sp. colourless, 21–23 μ × 9 μ. R. .... 8. M. interjecta A. L. Sm.

94. **OPEGRAPHA** Humb.—Thallus crustaceous, developed under the bark or superficial, generally thin, sometimes wanting. Algal cells *Trentepohlia*. Apothecia (lirellæ) black and carbonaceous, superficial, rarely innate, elongate or short and roundish, simple or branched with proper margins only; disc slit-like, rarely flattened; asci broadly clavate or elongate, usually 8-spored; spores colourless or becoming brownish, linear-oblong, fusiform or acicular, 3-multi-septate.

The thallus of corticolous species is mainly developed below the bark (hypophlœodal) and is generally visible as a thin film or stain of a whitish or brown colour; on rocks it often attains to greater superficial thickness. The lirellæ are superficial (innate at first in *O. herpetica*), and are often variable so that spore characters are important in determination. Where not indicated the spores are fusiform.

*Spores 3- (rarely 4-) septate. Apothecia variable.
On trees, rarely on pales. Thallus immersed.
Apo. short, crowded, dilated in age; sp. 17–27 μ × 4–5 μ. F. .... 1. O. herpetica Ach.
Apo. black groups; disc uniform; sp. obovate-fusiform, 16–20 μ × 4 μ. C. 3. O. atra Pers.
Apo. stouter, prominent; disc uniform; sp. 17–23 μ × 5–7 μ. F. .... 5. O. betulina Sm.
On rocks. (*O. saxicola* var. *Decandollei* and *O. calcarea*, chiefly calcicolous.)
Thallus light in colour (grey or brown in *O. saxicola*).
CaCl + red. Thick, farinose. Apo. short, pruinose; sp. 15–17 μ × 3–4 μ. R. 9. O. grumulosa Duf.
K(CaCl) + red. Thick, farinose. Apo. short, pruinose; sp. 14–21 μ × 3–5 μ. R. .... 14. O. mirifica Stirt.
Thin, scurfy. Apo. scattered; sp. ellipsoid or clavate, 16–18 μ × 6 μ. S. .. 7. O. saxicola Ach.
Apo. congregate; sp. more elongate, 21–26 μ × 5 μ. S. .... Var. Decandollei Stiz.
Scanty, granulate. Apo. short; sp. 16 μ × 4 μ. R. .... 8. O. atrula Nyl.
Thin, areolate. Apo. short, pruinose; sp. oblong, 15–17 μ × 3–4 μ. R. ... 10. O. nothiza Nyl.
Tartareous. Apo. curved, congregate; sp. subclavate, 14–18 μ × 4–6 μ. C. 11. O. calcarea Turn.
Scanty. Apo. scattered. F. .... f. heteromorpha A. L. Sm.

Obsolete. Apo. stoutish, in dense groups; sp. elongate-ovate, 16–24 μ × 4–6 μ. S. .... 12. O. confluens Stiz.
Thin, areolate, yellowish. Apo. scattered; sp. 15–18 μ × 5–6 μ. R. .... 13. O. xanthodes Nyl.
**Spores 5–7-septate. Apothecia variable.
On trees or wood. Thallus immersed.
Apo. prominent, stoutish; sp. broadly fusiform, 20–30 μ × 7–9 μ. C. ...... 16. O. varia Pers.
Apo. prominent, slender; sp. (rarely 9-sept.) 15–27 μ × 2–4 μ. C. .... 17. O. vulgata Ach.
Apo. in radiate stellate groups. C. ... Var. siderella Nyl.
On sandy soil and old wood.
Apo. long, in groups; sp. 30 μ × 4–6 μ. R. (Channel Islands) .... 18. O. areniseda Nyl.
On rocks. Thallus thin.
Brown, yellowish-sorediate, with black lines. Apo. short; sp. 16–21 μ × 3–4 μ. S. .... 19. O. zonata Koerb.
Yellowish-green, areolate. Apo. minute; sp. 23–25 μ × 8–9 μ. Cal. R. ...... 15. O. paraxanthodes Nyl.
Scanty, white. Apo. short; sp. 17–21 μ × 4 μ. S. .... 20. O. cæsariensis Nyl.
Light, dark, or wanting. Apo. slender, long; sp. 20–28 μ × 3–5 μ. R. ...... 21. O. lithyrga Ach.
Brown, continuous. Apo. linear, small; sp. 32 μ × 6 μ. R. .... 22. O. lithyrgodes Nyl.
Light, pulverulent. Apo. long and stout; sp. 25–31 μ × 5–6 μ (central cells large). R. .... 23. O. Leightonii Cromb.
***Spores 7–17-septate.
On trees or on wood.
Whitish. Apo. pruinose; sp. 22–30 μ × 4 μ. F. .... 24. O. lyncea Borr.
Thick, dull-brownish. Apo. stout; sp. 50–60 μ (or more) × 6 μ. R. .... 25. O. prosodea Ach.
Thin, brownish. Apo. small, scattered; sp. 40–80 μ × 6–7 μ. F. .... 26. O. viridis Pers.
Apo. longer, massed in groups. Yew. F. f. taxicola Cromb.
Thin, brownish. Apo. roundish, flattened; sp. multi-septate, long. Holly. R. .... 27. O. involuta Nyl.

95. **GRAPHIS** Adans.—Thallus crustaceous, developed under the bark or superficial. Algal cells *Trentepohlia*. Apothecia (lirellæ) mostly black and carbonaceous, elongate, rarely roundish, immersed then erumpent, simple or branched, the proper margins prominent, furrowed or even, hypothecium colourless or dark-coloured; asci clavate or elongate, usually 8-spored; spores colourless, elongate, pluri-septate, the cells transversely lentiform.

The genus differs from *Opegrapha* in the generally larger lirellæ, but chiefly in the character of the spore cells. Most of the species are corticolous. The furrows along the margins of some lirellæ are due to new disc formations and become more distinct with age, they are sometimes difficult to determine. The lirellæ of all the species vary in their arrangement on the thallus, in length, and in width of the disc. The spores may become brownish by degeneration.

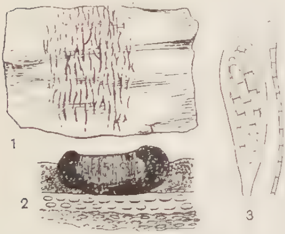


FIG. 64.—*Opegrapha atra* Pers.
1. Plant on bark. 2. Vertical section of apothecium × 50. 3. Ascus with spores and paraphysis × 300.

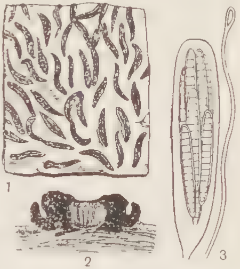


FIG. 65.—*Graphis elegans* Ach.
1. Plant on bark. 2. Vertical section of apothecium × 50. 3. Ascus with spores and paraphysis × 250.

*Margins more or less longitudinally furrowed.
  Sp. 10–12-sept., 35–55 μ × 8–11 μ. Trees. C. .... 1. G. elegans Ach.
    Apo. parallel, rather long, f. *parallela* Leight.; radiate-stellate, f. *stellata* Leight; aggregate in groups, f. *coacervata* Leight.
  Sp. 7–11-sept., 35–45 μ × 7–11 μ. Rocks. R. 2. G. petrina Nyl.
  K + y, then orange. Sp. 10–12 sept., 35–45 μ × 8–10 μ (or larger). Holly. R. 3. G. ramificans Nyl.
**Margins not furrowed.
  Thallus cream-coloured or olivaceous, generally, immersed.
    Sp. 7–10-sept., 20–45 μ × 7–10 μ. Trees. C. .... 4. G. scripta Ach.
      Apo. parallel, f. *recta* Leight. F.
        In stellate groups; disc often pruinose. S. .... Var stellata Mudd.
  Thallus whitish, superficial.
      Apo. crowded, curved; disc subpruinose. C. .... Var. serpentina Nyl.
      Apo. long, curved; disc plane, pruinose. R. .... Var. pulverulenta Ach.

96. **PHÆOGRAPHIS** Muell.-Arg.—Thallus crustaceous, immersed or superficial. Algal cells *Trentepholia*. Apothecia (lirellæ) mostly black, elongate or rarely roundish; spores 8 in the ascus, becoming brown, pluriseptate; spore cells transversely lentiform.

Distinguished by the brown colour of the septate spores. British species are corticolous.

Light-coloured, rather short, immersed; disc plane, naked or pruinose; hypo. colourless; sp. 5–7-sept., 28–38 μ × 9 μ. S.	1. Ph. inusta Muell.-Arg.
More elongate, acute at ends, f. *divaricata* A. L. Sm.	
Short, crowded. F.	Var. macularis A. L. Sm.
K + y, then red. Light-coloured. Apo. branched and radiating; disc plane, pruinose; hypo. thin; sp. 7–8-sept., 42–48 μ × 9–12 μ. C.	2. Ph. dendritica Muell.-Arg.
Kf + y. Pale-olive or dark. Apo. with white pulverulent margin; disc plane, pruinose; hypo. dark; sp. 5–7-sept., 17–33 μ × 6–8 μ. S.	3. Ph. Lyellii Zahlbr.

97. **GRAPHINA** Muell.-Arg.—Thallus crustaceous, immersed or superficial. Algal cells *Trentepohlia*. Apothecia (lirellæ) elongate, the proper margins furrowed or simple; spores usually 8 in the ascus, rather large, colourless, muriform.

Distinguished by the colourless muriform spores. British species are corticolous.

Thallus light coloured.	
Thin or thickish, tartareous, crowded; disc narrow; hypo. colourless or brownish; sp. 30–75 μ × 15–20 μ. F.	1. G. anguina Muell.-Arg.
Apo. in stellate radiate groups, f. *radiata* A. L. Sm.	
Thicker, pulverulent. Apo. flexuose; disc often dilated and pruinose. F.	Var. pulverulenta A. L. Sm.
K + y. Thin. Apo. scattered, short; disc broad, pruinose; sp. 35–48 μ × 12–20 μ. R.	2. G. inustula A. L. Sm.
Thin. Apo. elongate; disc narrow; hypo. dark; sp. 30–45 μ × 10–18 μ. F.	3. G. Ruiziana Muell.-Arg.

FAMILY XXV. CHIODECTONACEÆ.

Thallus crustaceous. Algal cells usually *Trentepohlia*. Apothecia aggregate in specialized prominent stroma-like portions of the thallus (verrucæ), deeply immersed, immarginate, small and punctiform or elongate; asci elongate-clavate; spores elongate, pluri-septate, colourless or coloured.

Characterized by the arrangement and form of the apothecia. The family is well represented in tropical countries; in Great Britain there are only a few species in the following genera:—

Apothecia immarginate.	
Hypothecium colourless or thinly black.	
Spores colourless	98. **Enterographa.**
Spores brown	99. **Sclerophyton.**
Hypothecium thick and black	100. **Chiodecton.**
Apothecia marginate; spores colourless	101. **Glyphis.**

98. **ENTEROGRAPHA** Fée (*Stigmatidium*, Meyer).—Thallus crustaceous, thickish, limited by a black hypothallus. Apothecia aggregate in lines or solitary, roundish or shortly elongate, immarginate, deeply immersed in the verrucæ; hypothecium colourless or thinly black, paraphyses slender, branched; spores 8 in the ascus, elongate-fusiform, colourless, pluri-septate.

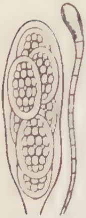


FIG. 66.—*Graphina anguina* Muell.-Arg. Ascus with spores and paraphysis × 250.

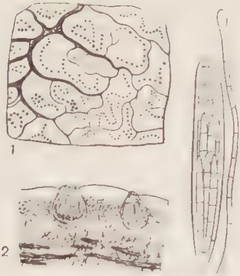


FIG. 67.—*Enterographa crassa* Fée. 1. Plant on bark. 2. Vertical section of thallus and apothecia × 40. 3. Ascus with spores and paraphysis × 375.

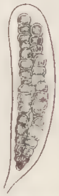


FIG. 68.—*Sclerophyton circumscriptum* A. Zahlbr. Ascus with spores × 300.

The deeply immersed blackish fructifications sometimes resemble perithecia as the disc may be contracted to a small opening. The graphideine character is apparent in species with elongate apothecia. The species grow mostly on trees.

Thallus whitish to cream-coloured or brownish.
  Verrucæ flat, wide spreading. Apo. punctiform, generally in lines; sp. 5–7-sept., 24–35 μ × 5 μ. Trees. C. .... 1. E. crassa Fée.
    Thicker areolate thallus, f. *saxicola* Cromb. Rocks. R.
  Verrucæ flat, small. Apo. small oblong, variable; sp. 5–7- (or more-)sept., 25–30 μ × 4 μ. Rocks, rarely trees. F. .... 2. E. Hutchinsiæ Koerb.
  Verrucæ thickish spreading. Apo. elongate; sp. up to 13-sept., 38–44 μ × 4 μ. Trees. R. 3. E. venosa Massal.

99. **SCLEROPHYTON** Eschw.—Thallus crustaceous. Apothecia roundish or elongate, thickly grouped, often confluent; hypothecium colourless; paraphyses slender, branched; asci clavate, 8-spored; spores elongate-clavate or fusiform, pluriseptate, brown.

Differs from *Enterographa* in the brown spores. In the single British species the fertile verrucæ are scarcely distinguishable from the thick deeply cracked thallus.

Thallus whitish, thick. Apo. punctiform, aggregate, solitary or in lines; sp. 4–7-sept. 20–25 μ × 5 μ. Rocks (not calcareous). F. 1. S. circumscriptum A. Zahlbr.

100. **CHIODECTON** Ach.—Thallus crustaceous, whitish, thin or thickish. Apothecia black, immersed in the verrucæ, often confluent at the base; hypothecium thick, blackish-brown; paraphyses slender, branched; spores elongate, 2-pluri-septate, colourless.

Distinguished by the thick dark hypothecium. When several fruits are confluent a stromatoid structure is formed. The British species are all rare, they grow in S. England, the Channel Islands or S. and W. Ireland.

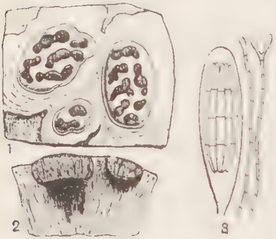


FIG. 69.—*Chiodecton albidum* Leight.
1. Plant on rock × 10. 2. Vertical section of thallus and apothecia × 25. 3. Ascus with spores and paraphyses × 400.

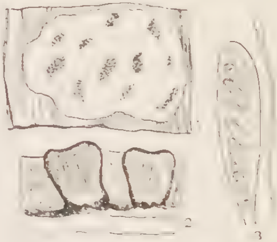


FIG. 70.—*Glyphis labyrinthica* Ach.
1. Plant on bark. 2. Vertical section of thallus and apothecia × 30. 3. Ascus with spores and paraphysis × 250.

On rocks.
  Thin pulverulent. Sp. 3-sept., 30–40 μ × 5–6 μ ... 1. C. albidum Leight.
  Thick, cretaceous. Apo. pruinose; sp. 30–40 μ × 3 μ .... 2. C. petræum Del.
  Granular. Sp. oblong-clavate, 3-sept., 11–16 μ × 3–5 μ .... 4. C. subdiscordans Nyl.
On bark of myrtle and heath.
  Granular or farinose. Sp. 2–3-sept., 36–48 μ × 4 μ .... 3. C. myrticolum Fée.

101. **GLYPHIS** Ach. Thallus crustaceous with more or less prominent verrucæ. Apothecia immersed, roundish or elongate, simple or branched, with a dark margin; paraphyses simple; asci elongate, 4–8-spored; spores elongate, pluri-septate colourless.

Essentially a tropical genus. In the single British species (from Killarney) the thallus is whitish or brownish-olivaceous and thin, with white pulverulent verrucæ.

Apothecia slender, in reticulate lines; sp. 3–5-sept., 21 μ × 6·5 μ .... G. labyrinthica Ach.

SERIES II. PYRENOCARPEÆ.

[illegible] sphaeriacs

This series corresponds with Pyrenomycetes among fungi; the fruiting body is a closed perithecium, mostly opening above by a pore or ostiole.

Perithecia solitary.	
Thallus evident. Perithecia opening by a pore.	
Algal cells Myxophyceæ.	
Thallus minutely crustaceous, squamulose or fruticose	XXVI. PYRENIDIACEÆ.
Algal cells Chlorophyceæ.	
Algæ Protococcaceæ.	
Thallus squamulose or foliose	XXVII. DERMATOCARPACEÆ.
Thallus crustaceous	XXVIII. VERRUCARIACEÆ.
Algæ Trentepohliaceæ	XXIX. PYRENULACEÆ.
Thallus not evident. Perithecia without a pore	XXX. THELOCARPACEÆ.
Perithecia compound or united.	
Perithecia in a common stroma	XXXI. TRYPETHELIACEÆ.
Perithecia in a common peridium	XXXII. MYCOPORACEÆ.

FAMILY XXVI. PYRENIDIACEÆ.

Thallus minutely crustaceous, squamulose or fruticose. Algal cells Myxophyceæ. Perithecia superficial or immersed; spores 4-8 in the ascus, simple or septate, colourless or coloured.

The family is poorly represented in the British Isles. *Pyrenidium* Nyl. is a doubtful genus. "*Lophothelium*" Stirt. formerly included has proved on examination to be the fungus, *Microthelia*, parasitic on the squamules of *Stereocaulon condensatum*. *Obryzum* is parasitic.

Thallus squamulose. Perithecia wanting	102. **Coriscium.**
Thallus minutely shrubby	103. **Pyrenidium.**
Thallus wanting	104. **Obryzum.**

102. **CORISCIUM** Wainio.—Thallus squamulose, lower surface of loose straggling hyphæ. Algal cells *Microcystis* (*Polycoccus* Kuetz.) occurring in compact crowded groups. Perithecia and spermogones unknown.

Formerly included in *Normandina*, but placed here because of the blue-green gonidia. There is only one widely distributed species, the thallus of which consists of crowded or scattered squamules, bluish-green, white below, rounded or neatly crenate-lobate, with pale upturned edges less or more than 2 mm. in diam.

On turfy soil, on mosses, in bogs, etc. C. .... C. viride A. Zahlbr.

103. **PYRENIDIUM** Nyl. Thallus minutely fruticose, rising from a crustaceous base, with a distinct plectenchymatous cortex. Algal cells *Nostoc*. Perithecia innate, opening by a pore; spores oblong-ellipsoid, brownish, septate.

A monotypic genus recorded only from S. and S.W. England on cretaceous or calcareous pebbles. As has been suggested the perithecium may be that of a fungus parasitic on a lichen, presumably a *Leptogium*.

Spores 3-septate, brownish, 20–24 $\mu \times$ 8–9 μ ... P. actinellum Nyl.

104. **OBRYZUM** Wallr.—Thallus none. Perithecia minute, globose, immersed in the tissue of the host-plant or almost superficial, opening above by a pore; paraphyses none; spores 8 in the ascus, fusiform, becoming 1- or more-septate, colourless.

The species of this genus are frequently classified among fungi. Abbé Vonaux has included the British species under *Sphærulina*.

On *Leptogium*.
  Perithecia immersed or superficial. Spores guttulate, 16–21 $\mu \times$ 5–6 μ. .... 1. O. corniculatum Wallr.
On *Collema*.
  Perithecia projecting like minute golden balls. Spores 3–5-sept., 23–27 $\mu \times$ 4–5 μ.... 2. O. dolichoteron Nyl.

FAMILY XXVII. DERMATOCARPACEÆ.

Thallus foliaceous, squamulose or subcrustaceous, corticate on one or both surfaces, or non-corticate; under surface naked or with rhizinæ. Algal cells Protococcaceæ. Perithecia simple, more or less immersed in the thallus, opening by a pore at the apex. Spermogones with short straight spermatia.

The thallus when foliose is thick and leathery. The perithecia of *Endocarpon* contain hymenial gonidia, which escape with the ascospores as in *Staurothele*.

Gonidia not present in hymenium.
  Spores simple .... 105. **Dermatocarpon.**
  Spores septate .... 106. **Normandina.**
  Spores muriform .... 107. **Dacampia.**
Gonidia present in hymenium.
  Spores muriform .... 108. **Endocarpon.**

105. **DERMATOCARPON** Eschw. Thallus foliose or squamulose, corticate on both surfaces or on the upper surface only, sometimes with rhizinæ. Perithecia immersed in the thallus, globose or ovate, with a projecting ostiole; paraphyses usually mucilaginous and cohering, or sparingly developed and branched; spores 8–16 in the ascus, simple, colourless.

*Thallus foliose thickish, grey to brown.
  Lobes mostly from one centre, simple or massed. Peri. prominent. Damp rocks. C. .... 1. D. miniatum Th. Fr.
    Lobes smaller. R. .... Var. leptophyllum Dalla Torre & Sarnth.
    Lobes numerous, ascending. C. .... Var. complicatum Th. Fr.
  Lobes numerous, spreading. Peri. innate. Rocks under water. F. .... 2. D. aquaticum A. Zahlbr.
    Lobes minute, crisped and recurved. Maritime rocks. R. .... Var. euplocum A. L. Sm.

**Thallus squamulose. Squamules various.

Brownish-red, rhizinose below. Sp. 13–18 $\mu \times 8\ \mu$. Earth among rocks. F.	3. D. lachneum A. L. Sm.
Brown or dark fibrillose below. Sp. 11–16 $\mu \times 6$–$8\ \mu$. Ground and walls. F.	4. D. hepaticum Th. Fr.
Appressed, grey-brown, black below. Sp. 18–22 $\mu \times 8$–$11\ \mu$. Ground. F.	5. D. cinereum Th. Fr.
Appressed, pale dusky-olive. Sp. 40–45 $\mu \times 15\ \mu$. Rocks. R........................	6. D. macrocarpon A. L. Sm.

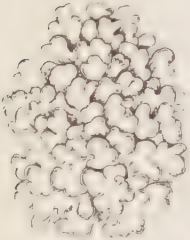


FIG. 71.—*Coriscium viride* A. Zahlbr. Plant from soil.

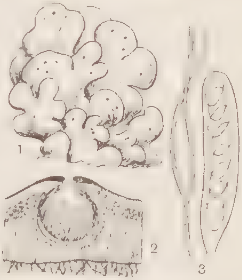


FIG. 72.—*Dermatocarpon lachneum* A. L. Sm. 1. Plant from soil. 2. Vertical section of thallus and perithecium × 25. 3. Ascus with spores and paraphysis × 300.

106. **NORMANDINA** Nyl.—Thallus squamulose, the squamules adnate, raised at the margins, non-corticate. Perithecia immersed; paraphyses wanting; spores cylindrical, pluri-septate, colourless, becoming brownish.

A monotypic genus, the single species being of very wide distribution but not very common. The rounded squamules, dainty and shell-like, spread over mosses on trees.

Glaucous-greenish-grey. Spores 6–7-sept., 28–40 $\mu \times 6$–$10\ \mu$	N. pulchella Cromb.

107. **DACAMPIA** Massal.—Thallus squamulose, spreading with a black subiculum. Perithecia entire, blackish; paraphyses persistent, branched; asci elongate; spores ellipsoid-fusiform, variously septate and muriform, brown.

In transverse section the white thallus contrasts strongly with the stout dark-brown hyphæ of the subiculum. The perithecia rise from the subiculum. Dacampia is a mountain lichen; it is plentiful on the summit of Ben Lawers.

White, farinose, not corticate. Sp. 20–35 $\mu \times 10$–$12\ \mu$	D. Hookeri Massal.

108. **ENDOCARPON** Hedw.—Thallus squamulose or almost crustaceous, corticate on both surfaces or on the upper only. Perithecia immersed,

containing hymenial gonidia; the ostiole more or less prominent; paraphyses mucilaginous, disappearing; spores 1–6 (usually 2) in the ascus, elongate-ellipsoid, muriform, brown.

Distinguished from *Dermatocarpon* by the hymenial gonidia and by the muriform spores which in all the species measure up to 55 μ × 19 μ. The species grow on soil or on mud walls.

Sq. brown, small, closely appressed, scattered. Ostiole black .... 1. E. pusillum Hedw.
Sq. brown, rather larger and lobed. Ostiole powdery with soredia .... 2. E. sorediatum Hook.
Sq. pale-brown, minute, crowded imbricate. Ostiole black .... 3. E. pallidum Ach.

FAMILY XXVIII. VERRUCARIACEÆ.

Thallus crustaceous, superficial or developed within the substratum, not corticate. Algal cells Protococcaceæ, sometimes present in the hymenium. Perithecia simple, globose or semi-globose, more or less immersed, opening by a pore at the apex (ostiole); asci 2–8-spored; paraphyses disappearing in mucilage or persistent. Spermogones with septate sterigmata and oblong or ellipsoid pleurogenous spermatia.

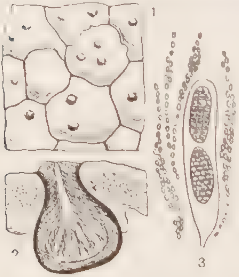


FIG. 73.—*Endocarpon pusillum* Hedw.
1. Portion of plant × ca. 12. 2. Vertical section of thallus and perithecium × 50. 3. Ascus with spores and hymenial gonidia × 210.

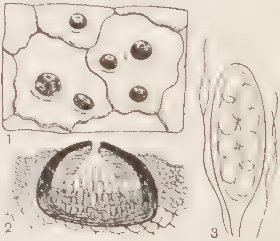


FIG. 74.—*Verrucaria papillosa* Ach.
1. Portion of plant × 10. 2. Vertical section of thallus and perithecium × 75. 3. Ascus with spores and paraphyses × 300.

Distinguished by the crustaceous thallus, bright-green gonidia and simple perithecia.

Gonidia not present in hymenium.
  Paraphyses disappearing.
    Spores simple, ellipsoid .... 109. **Verrucaria.**
    Spores simple, vermiform .... 110. **Sarcopyrenia.**
    Spores 1–3-septate .... 111. **Thelidium.**
    Spores muriform .... 112. **Polyblastia.**

Paraphyses persistent.
  Spores simple .... 113. **Thrombium.**
  Spores multi-septate .... 114. **Gongylia.**
  Spores muriform .... 115. **Microglæna.**
Gonidia present in hymenium.
  Spores muriform .... 116. **Staurothele.**

109. **VERRUCARIA** Pers.—Thallus crustaceous, continuous, areolate or pulverulent, sometimes developed within the substratum. Perithecia moderate in size (about ·5 mm. in diam.), smaller or larger, immersed or superficial, the outer wall or peridium carbonaceous or horny, completely surrounding the perithecium (entire) or developed only over the upper part (dimidiate), frequently thickish above and thin below, opening above by a pore or slit (ostiole); paraphyses soon becoming mucilaginous and disappearing; filaments within the ostiole (periphyses) often well developed; asci 8-spored; spores ellipsoid or subglobose, colourless, rarely brownish.

The species are almost exclusively saxicolous; those on limestone or mortar penetrate the substratum more or less, and the perithecia may be formed in pits scooped out from the rock (foveolate). Many of the species grow in moist places in or near streams; others grow by the sea-shore, often within reach of the waves. The records of lignicolous species in this and the following genera are doubtful. Spore-sizes have been given, as they are helpful in determination.

A. Maritime species. Thallus more or less gelatinous when moist.
  Brownish-black, finely areolate. Peri. semi-immersed; sp. 12–17 $\mu \times$ 7–8 μ. C. ...... 1. V. maura Wahlenb.
    Th. not areolate; sp. longer and narrower. R. .... Var. memnonia Koerb.
  Dark-olive or -green, gelatinous, thick. Peri. immersed; sp. 7–10 $\mu \times$ 5–6 μ. F. ...... 2. V. mucosa Wahlenb.
  Dark-olive, gelatinous, thin. Peri. more prominent, shining; sp. 7–10 $\mu \times$ 4–5 μ. F. 3. V. microspora Nyl.
  Blackish-green, thin. Peri. minute, prominent; sp. 15–18 $\mu \times$ 2–4 μ. R. 3a. V. Lorrain-Smithiæ Knowl.
  Dark shining ridges. Peri. minute, sessile; sp. 8–9 $\mu \times$ 4–5 μ. R. .... 4. V. striatula Wahlenb.
    Th. more continuous with scattered dots and ridges .... f. continua Knowl.
  Dark-brown, scabrid. Peri. prominent; sp. 10–17 $\mu \times$ 5–9 μ. R. .... 5. V. scotina Wedd.
  Greenish-white, tartareous. Peri. prominent, large; sp. 18–20 $\mu \times$ 7–10 μ. R. .... 36. V. prominula Nyl.

B. Aquatic species growing in or near streams or lakes. Thallus subgelatinous.
    Thallus dark, mostly olivaceous, brown or black.
      Thin, continuous. Peri. minute almost immersed; sp. subglobose, 6–8 $\mu \times$ 5–7 μ. R. .... 6. V. aquatilis Mudd.
      Thin or thickish, smooth. Peri. semi-immersed; sp. 19–26 $\mu \times$ 8–18 μ. S. 9. V. hydrela Ach.

Deeply cracked. Peri. semi-immersed; sp. 18–24 μ × 10–11 μ. F. .... 10. V. lævata Ach.
Thickish, smooth. Peri. semi-immersed; sp. 17–20 μ × 5–7 μ. R. 11. V. degenerascens Nyl.
Thin, smooth. Peri. emerging; sp. 24–35 μ × 10–16 μ. S. .... 12. V. margacea Wahlenb.
Reddish-grey, less gelatinous. Peri. almost sessile; sp. 30–35 μ × 12–15 μ. R. .... 13. V. latebrosa Koerb.
Olive, thin, cracked when dry. Peri. entire, emerging; sp. 14–24 μ × 6–10 μ. F. .... 14. V. æthiobola Wahlenb.
Thallus evanescent. R. .... Var. acrotella A. L. Sm.
Greenish, then dark. Peri. dimidiate, emerging; sp. 15–24 μ × 6–10 μ. F. 15. V. submersa Schær.
Greyish, areolate. Peri. on a slight elevation; sp. 18–24 μ × 6–10 μ. F. 16. V. papillosa Ach.

C. Species in dry situations—on mortar, walls or rocks.

*Thallus effuse, cracked-areolate, thickish.
Pale, or olive-brown. Peri. large, emergent; sp. 18–35 μ × 10–17 μ. C. 17. V. viridula Ach.
Tawny-brown, subsquamulose. Peri. large, ostiole emergent; sp. 25–35 μ × 12–20 μ. F. .... 19. V. macrostoma DC.
**Thallus determinate, dark.
Thin, cracked or uneven. Peri. emergent; sp. 15–24 μ × 5–9 μ. Mostly limestone. C. .... 23. V. nigrescens Pers.
Very thin, subsmooth. Peri. small; sp. 16–22 μ × 8–10 μ. Mostly sandstone. S. .... 24. V. mauroides Schær.
Thickish, very dark; sp. 18–24 μ × 10–12 μ. On granite (not British) 25. V. cataleptoides Nyl.
Bright ochraceous-red, areolate. Cal. R. .... f. ferruginosa Lamy.
***Thallus determinate, light-coloured. Calcicolous.
Bluish, greyish or greyish-brown, thick, faintly cracked. Peri. small; sp. 14–19 μ × 4–7 μ. S. .. 26. V. coerulea DC.
Mouse-grey, thin, determinate or effuse. Peri. small; sp. 18–24 μ × 6–12 μ. R. 27. V. murina Leight.
Umber-brown, finely cracked. Peri. minute; sp. small, 12 μ × 4 μ. R. 28. V. pinguicula Massal.
Greyish-brown, cracked. Peri. prominent; sp. 11–15 μ × 5–6 μ. R. 29. V. peloclita Nyl.
****Thallus determinate, with mosaic-like areolæ. Calcicolous.
Leaden-grey, thickish. Peri. sometimes confluent; sp. 10–20 μ × 5–8 μ. F. .... 30. V. glaucina Ach.

Dark-greyish-brown, thickish. Peri. scarcely visible; sp. 11–16 μ × 4–6 μ. S. .... 31. V. fuscella Ach.

*****Thallus membranaceous, continuous, smooth. On calcareous rocks, flints and stones.

Very thin, spot like, dark-brown. Peri. small, immersed; sp. 14–24 μ × 6–10 μ. S. 32. V. maculiformis Krempelh.

Thin, like a dark oily stain. Peri. prominent; sp. 8–12 μ × 5–7 μ. R.. 33. V. mutabilis Borr.

******Thallus tartareous, light-coloured. Calcicolous.

†Perithecia not forming pits.

Thin, smooth, determinate. Peri. prominent; sp. 15–22 μ × 6–10 μ. F. .... 34. V. Dufourii DC.

Tartareous, brownish (*see* maritime species) .... 36. V. prominula Nyl.

Sp. almost globose, 10–12 μ × 7–9 μ .... Var. viridans Nyl.

Sp. 14–17 μ × 6–7 μ .... Var. minor A. L. Sm.

Thin, limited by wide blackish lines. Peri. minute; sp. 12–14 μ × 6 μ. R. .... 37. V. limitata Krempelh.

Whitish. Peri. small, semi-immersed; sp. 17–25 μ × 10–12 μ. C. .... 38. V. muralis Ach.

††Perithecia forming pits in the rocks (foveolate).

Peri. wall dimidiate; sp. 18–30 μ × 8–13 μ. C. .... 39. V. rupestris Schrad.

Peri. wall entire, spreading at base; sp. 23–32 μ × 10–20 μ. F. ...... 40. V. integra Carroll.

Th. tinged rose. Peri. entire, in deep pits; sp. 24–36 μ × 10–15 μ. S. 41. V. dolomitica Massal.

Th. tinged rose. Peri. emerging; sp. 18 μ × 9 μ (doubtfully British) 42. V. marmorea Zahlbr.

Th. ashy-grey, thin. Peri. minute, entire; sp. 12–17 μ × 5–7 μ. R. 43. V. parva Deakin.

Th. thin whitish. Peri. fissured above; sp. 15–21 μ × 8–10 μ. F. .... 44. V. calciseda DC.

110. **SARCOPYRENIA** Nyl.—Thallus crustaceous. Perithecia simple, scattered, with a black peridium, opening by an ostiole; paraphyses disappearing; asci oblong-clavate, soon disappearing, 8-spored; spores one celled, colourless, cylindrical-vermiform, slightly flexuose or twisted in the middle, the ends clavate.

Only one species has been recorded:—

Th. thin, yellowish-grey. Sp. 30–40 μ × 3–4 μ. Sandstone. R. .... S. gibba Nyl.

111. **THELIDIUM** Massal. — Thallus variously crustaceous, uniform, sometimes wanting. Perithecia black, simple, superficial or immersed, entire or dimidiate, with a simple ostiole; paraphyses mucilaginous, soon disappearing; asci usually somewhat large and saccate, 8-spored; spores ellipsoid or ovoid, usually rather large, 1–3 septate, colourless or sometimes brownish.

Thallus and perithecia are similar in form and size to those of *Verrucaria*, the distinguishing feature is the septation of the spores. The species are saxicolous or terricolous, and are rather rare, or have been overlooked.

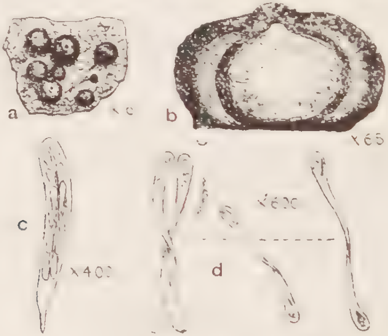


FIG. 75.—*Sarcopyrenia gibba* Nyl.
a. Plant on rock × 6. b. Vertical section of perithecium × 65.
c. Ascus with spores × 400. d. Spores × 600.

*Spores 1-septate.

On calcareous rocks.

Peri. rather large, not forming pits; sp. 20–32 μ × 10–18 μ. S. 1. Th. pyrenophorum Massal.

Peri. forming pits; sp. 25–38 μ × 12–17 μ. S. .... 3. Th. immersum Mudd.

On siliceous rocks, perithecia rather small.

Thin, pale; sp. 12–17 μ × 5–6 μ. R. ..... 2. Th. mesotropum A. L. Sm.

Thin, greyish green; sp. 22–30 μ × 9–12 μ. R. .... 4. Th. Nylanderi Krempelh.

On soil among mosses.

Thin, green or dark; sp. 16–28 μ × 7–11 μ. R. .... 4a. Th. terrestre Wats.

**Spores 3-septate.

On calcareous rocks.

Peri. minute, superficial; sp. 26–32 μ × 12–14 μ. R. 7. Th. microcarpum A. L. Sm.

Peri. larger, forming pits; sp. 35–53 μ × 12–21 μ. R. .... 8. Th. incavatum Mudd.

On siliceous rocks.

Peri. small; sp. 21–32 μ × 10–15 μ. Stones in streams. R. .... 5. Th. cataractarum Mudd.

Peri. larger; sp. 35–50 μ × 15–20 μ. Damp rocks. F. .... 6. Th. papulare Arn.

112. **POLYBLASTIA** Massal. – Thallus variously crustaceous, sometimes developed within the substratum. Perithecia simple, superficial or immersed; ostiole a simple pore; paraphyses mucilaginous, disappearing; asci broadly clavate, 1–8-spored; spores large, ellipsoid, muriform, colourless or dark-coloured.

Resembling *Verrucaria* in thallus and perithecia, but differing in spore characters. The spores may vary greatly in size and form and in septation. The species grow on rock, or soil, or on mossy earth. They are all rather rare.

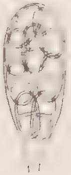


FIG. 76.—*Thelidium pyrenophorum* Koerb. Ascus with spores × 300.

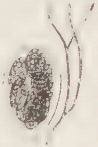


FIG. 77.—*Polyblastia theleodes* Th. Fr. Ascus with spores and paraphysis × ca. 65.

*Spores colourless.

On calcareous or siliceous rocks.

Peri. moderate, prominent; sp. 24–42 μ × 15–21 μ .... 1. P. intercedens Lönnr.

Peri. small, crowded; sp. 18–28 μ × 11–16 μ 3. P. fuscoargillacea Anzi.

Peri. moderate; sp. 40–50 μ × 16–20 μ (on mortar)................................. 10a. P. mortensis Wats.

**Spores becoming brownish.

On calcareous rocks (forming pits).

Peri. moderate or small; sp. 40–45 μ × 12–17 μ .... 4. P. Schraderi A. L. Sm.

Peri. small; sp. 22–30 μ × 12–15 μ .... 5. P. deminuta Arn.

On siliceous rocks.

Peri. mostly moderate, papillate; sp. 33–62 μ × 17–32 μ........................ 6. P. inumbrata A. L. Sm.

On mossy earth. Thallus variable.

Whitish granular. Peri. minute; sp. 15–30 μ × 9–14 μ .... 9. P. Sendtneri Krempelh.

Dark-brown, gelatinous. Peri. prominent; sp. 30–45 μ × 12–21 μ .... 10. P. gelatinosa Th. Fr.

Greenish - olivaceous. Sp. 40–50 μ × 16–20 μ .... 10a. P. mortensis Wats.

Brown. Sp. mostly 2 in the ascus, 60–132 μ × 21–51 μ .... 11. P. tristicula Th. Fr.

***Spores becoming dark-brown.
On siliceous rocks. Perithecia rather large.
Thickish, wrinkled. Peri. semi-immersed; sp. 60–84 μ × 24–45 μ ... 12. P. theleodes Th. Fr.
Thinner and gelatinous. In streams f. inundata Th. Fr.
Thin. Peri. sessile; sp. 26–40 μ × 13–21 μ .... 13. P. scotinospora Hellb.
Th. thin. Peri. immersed; sp. 46–56 μ × 23–33 μ .... 14. P. Henscheliana Lönnr.
On mossy earth.
Black. Peri. small; sp. 21–36 μ × 9–14 μ .... 15. P. nigritella A. L. Sm.
Greenish or dark. Peri. small; sp. 18–28 μ × 7–9 μ........................ 16. P. gothica Th. Fr.

113. **THROMBIUM** Wallr.—Thallus crustaceous, uniform, sometimes developed within the substratum or altogether wanting. Perithecia simple, immersed or superficial, light- or dark-coloured, with a poriform ostiole; paraphyses persistent, slender, branched; spores 4–8 in the ascus, ellipsoid, simple, colourless or brownish.

A small genus of rare lichens, differing from *Verrucaria* in the persistent paraphyses. The spores are fairly small.

On rocks.
Bright-green, thickish gelatinous. Peri. immersed. Maritime .... 1. Thr. lætevirens A. L. Sm.
Reddish-brown, thin. Peri. sessile. On whinstone. 3. Thr. thelostomum A. L. Sm.
On soil.
Pale, gelatinous when moist. Peri. small, immersed .... 2. Thr. epigæum Wallr.

114. **GONGYLIA** Koerb.—Thallus crustaceous. Perithecia almost sessile, soft in texture, bright- or dark-coloured, with a poriform ostiole; paraphyses slender, free; spores 4–8 in the ascus, acicular, straight or somewhat bent, colourless, multiseptate.

A small genus with few representatives in Europe. The ostiole tends to widen out at maturity so that the perithecia seem to become almost disciform.

On sandy soil.
Bright-green. Peri. shining black; sp. 60–85 μ × 2–3 μ. R. .... 1. G. viridis A. L. Sm.

115. **MICROGLÆNA** Koerb.—Thallus crustaceous. Perithecia immersed or almost free; paraphyses persistent, branched; spores 2–8 in the ascus, ellipsoid, muriform, colourless or brownish.

Similar to *Polyblastia* in spore characters but differing in the persistent paraphyses. The perithecia are black or brown above and nearly always paler below. The thallus is variable in colour and thickness. None of the species are frequent.

On trees.
Whitish, thin. Peri. immersed; sp. 19–38 μ × 11–18 μ .... 1. M. modesta A. L. Sm.

On rocks.

Pale-yellow, in fragments. Peri. small, almost sessile; sp. 18–20 μ × 10 μ. 1a. M. breadalbensis Wheld. & Wils.

Yellowish-brown, thick. Peri. immersed; sp. 30–46 μ × 12–16 μ .... 2. M. isidioides A. L. Sm.

Whitish granular. Peri. immersed; sp. 18–22 μ × 7–11 μ (alpine). 3. M. corrosa Arn. var. nericiensis A. L. Sm.

Greyish granules. Peri. minute, sessile; sp. 16–20 μ × 6–8 μ (on pebbles) .... 3a. M. nuda Wheld. & Trav.

Brownish mucilaginous. Peri. immersed; sp. 50–55 μ × 10 μ. 4. M. Larbalestierii A. L. Sm.

On the ground, on mosses, etc.

Th. whitish. Peri. immersed; sp. 50–60 μ × 15–17 μ .... 5. M. Holliana A. L. Sm.

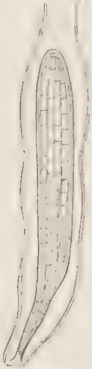


FIG. 78.—*Gongylia viridis* A. L. Sm. Ascus with spores and paraphyses × 300.

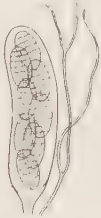


FIG. 79.—*Microglæna modesta* A. L. Sm. Ascus with spores and paraphysis × 300.

116. **STAUROTHELE** Norm.—Thallus crustaceous, sometimes developed within the substratum. Perithecia simple, with poriform ostioles, and with hymenial gonidia; paraphyses mucilaginous, disappearing; spores 1–8 in the ascus, large, ellipsoid, muriform, colourless or brown.

Distinguished from other Verrucariaceæ by the presence of algal cells within the perithecium alongside the asci, in this respect resembling *Endocarpon*. The algal cells are ejected along with the spores, and a new thallus is thus readily formed. The species are saxicolous and more or less rare.

Spores colourless, 8 in the ascus. Thallus white to brown.

Whitish. Peri. prominent; sp. 18–34 μ × 11–17 μ. Sil. & Cal. .... 1. St. hymenogonia A. Zahlbr.

Spores brown, 1–2 in the ascus.
On rocks in or near water.
Brownish, thin. Ostioles projecting; sp. 45–50 μ × 18–20 μ .... 2. St. umbrina A. L. Sm.
Brown, thickish. Ostioles depressed; sp. 32–53 μ × 12–23 μ .... 3. St. clopima Th. Fr.
Spores brown, 4–8 in the ascus.
On calcareous rocks. Perithecia in pits (foveolate).
Whitish, bluish-grey or smoky-brown: sp. 36–55 μ × 12–20 μ..................... 4. St. rupifraga Arn.

FAMILY XXIX. PYRENULACEÆ.

Thallus crustaceous, superficial or developed within the substratum, not corticate. Algal cells *Trentepohlia*. Perithecia simple, globose or semi-globose, more or less immersed, opening by a pore at the apex (*ostiole*). Spermogones globose or ovoid, with simple or sparingly branched sterigmata and acrogenous spermatia.

Distinguished by the yellowish filamentous gonidia and also by the more constantly persistent paraphyses. The following genera are found in the British Isles:—

*Perithecia scattered, simple.
†Paraphyses branched, entangled or rarely wanting.
Asci cylindrical; spores uniseriate.
Spores 1-septate................................ 117. **Acrocordia.**
Asci clavate or ovate, spores more or less massed.
Spores colourless.
Spores elongate-fusiform, 1–5-septate 118. **Arthopyrenia.**
Spores acicular, multi-septate............ 119. **Leptorhaphis.**
Spores brown.
Spores 1–5-septate.......................... 120. **Microthelia.**
††Paraphyses unbranched, distinct.
Spores colourless, 1–5-septate.
Spores 8 in the ascus..................... 121. **Porina.**
Spores many in the ascus................. 122. **Thelopsis.**
Spores brown.
Spores 1–5-septate, with short cells.... 123. **Pyrenula.**
**Perithecia often united.
Spores brown, muriform.................. 124. **Anthracothecium.**

117. **ACROCORDIA** Massal.—Thallus crustaceous. Perithecia simple, globose or somewhat conical, black, semi-immersed; paraphyses persistent, slender, branched and entangled; asci cylindrical, 8-spored; spores uniseriate in the ascus, ellipsoid, 1-septate, colourless.

Distinguished by the elongate asci with the spores in a single row. The spores are broadly ellipsoid, except in *A. monensis*. The perithecia are entire or dimidiate, with the wall sometimes spreading at the base.

On trees.

Peri. prominent, large; sp. 15–29 μ × 7–13 μ. C. .... 1. A. gemmata Koerb.

Peri. prominent, small; sp. 12–16 μ × 5–7 μ. C. .... 2. A. biformis Oliv.

On calcareous rocks or on mortar of walls.

Peri. dimidiate, spreading; sp. 15–23 μ × 7–9 μ. F. .... 3. A. epipolæa A. L. Sm.

Peri. entire; sp. 18–21 μ × 8–11 μ............ 4. A. Salweii A. L. Sm.

Peri. entire; sp. fusiform-ellipsoid, 20–33 μ × 6–10 μ. R. .... 5. A. monensis Wheld.

118. **ARTHOPYRENIA** Massal.—Thallus crustaceous. Perithecia simple, dark-coloured, mostly semi-immersed, globose or semi-globose; paraphyses branched and entangled, rarely mucilaginous and disappearing; asci elongate-ovate, 2–8-spored; spores elongate-ellipsoid, more or less constricted in the middle, 1- or more-septate, colourless.

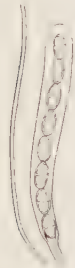


FIG. 80.—*Acrocordia gemmata* Koerb.
Ascus with spores and paraphysis × 210.

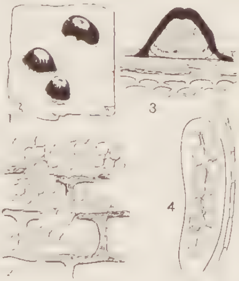


FIG. 81.—*Arthopyrenia fallax* Arn.
1. Plant on bark × ca. 12. 2. Vertical section of thallus × 300. 3. Vertical section of perithecium × 50. 4. Ascus with spores and paraphysis × 300.

When growing on the bark of trees the thallus is immersed (hypophlœodal), appearing mostly as a stain on the surface, with the perithecia dimidiate. On rocks there is sometimes a more superficial thallus, and the perithecia may be dimidiate or entire. The species were formerly included under *Verrucaria*.

*Spores 1-septate; cells equal or unequal.

A. Growing on trees.

†Thallus mostly light-coloured. Perithecia dimidiate; paraphyses entangled, often indistinct.

Peri. scattered; sp. cells equal, 15–24 μ × 4–7 μ. C. .... 1. A. epidermidis Mudd.

Peri. scattered; sp. cells almost equal, 14–17 μ × 3–5 μ. C. .... 2. A. punctiformis Arn.
Peri. often in groups; sp. clavate, 15–25 μ × 4–6 μ. R. .... 3. A. pyrenastrella Oliv.
Peri. immersed, pruinose; sp. cells constricted, 15–22 μ × 5–7 μ. F. 4. A. cinereopruinosa Koerb.
††Thallus light- or dark-brown. Paraphyses various.
Paraph. entangled; sp. cells equal, 16–22 μ × 7 μ. F. .... 5. A. analepta Massal.
Paraph. distinct, free; sp. cells unequal, 16–22 μ × 7–9 μ. C. .... 6. A. fallax Arn.
Paraph. indistinct; sp. often brownish, tapering, 27–40 μ × 7–10 μ. C. .... 7. A. stigmatella A. L. Sm.
Paraph. lax or coherent; sp. several-guttulate, 23–35 μ × 6–7 μ. R. 8. A. analeptoides A. L. Sm.
Paraph. branched, free; sp. fusiform, 15 μ × 4 μ. R. .... 9. A. byssacea A. L. Sm.
†††Thallus always rather dark-coloured.
Smooth. Sp. cells almost equal, 20–25 μ × 4–5 μ. R. .... 10. A. Laburni Sydow.
Filmy or rough. Sp. 13–17 μ × 3–5 μ. On *Graphis* sp. R. .... 11. A. microspila Koerb.
Irregular spots. Sp. 25–30 μ × 4–5 μ. Rare..................................... 12. A. Taylori Mudd.
Definite black spots. Sp. 20–35 μ × 5–7 μ, becoming brown. R. ... 13. A. aphorisasa A. L. Sm.

B. Growing on rocks, sand or soil or on mosses.

Thallus superficial.
Thin, greyish. Sp. 20–21 μ × 5 μ. Sil. R. 14. A. saxicola Massal.
Thin, dark. Sp. 15–20 μ × 5–8 μ. Sil. R. 15. A. spilobola A. L. Sm.
Thin, olive-green. Sp. 21–22 μ × 8 μ. Wet sand-banks. R. .... 16. A. arenicola A. L. Sm.
Grey, granular. Sp. broader upwards, 32–37 μ × 10 μ. Damp sandy shores. R. .... 17. A. areniseda A. L. Sm.
Thin, blackish. Sp. 27–44 μ × 8–12 μ. Mosses and soil. R. .... 18. A. bryospila A. L. Sm.
Thin, black. Sp. 32–45 μ × 10–13 μ. Moss. R. 20. A. colleta A. L. Sm.
Wanting. Sp. 23–37 μ × 7–9 μ. Parasitic on *Rhizocarpon*. R. .... 19. A. allogena A. L. Sm.

C. On rocks or shells by the sea. (Spores rarely 3-septate in *A. marina*.)

Thallus immersed or evanescent.
Peri. semi-immersed. Sp. 12–19 μ × 5–7 μ. Shells or rocks. F. .... 21. A. litoralis A. L. Sm.
Peri. leaving pits. Sp. 15–18 μ × 6–7 μ. Shells. R. .... 22. A. foveolata A. L. Sm.
Thallus superficial on rocks.
Dark-green, subgelatinous. Sp. subclavate, 16–18 μ × 5 μ. R. .... 23. A. leptotera A. L. Sm.

Thin, black, subgelatinous. Sp. subclavate, 13–15 μ × 5–7 μ. R. 24. A. halodytes var. Hollii A. L. Sm.
Thin, pale-green. Sp. subclavate, 10–12 μ × 5–7 μ. S. .... 25. A. halizoa A. L. Sm.
Thin, greenish. Sp. oblong, 17–19 μ × 6–7 μ. R. .... 26. A. viridula A. L. Sm.
Dark-green, subgelatinous. Sp. 3-sept. when mature, 9–14 μ × 3–5 μ. R. .... 27. A. marina A. L. Sm.

**Spores 3-septate.
  On trees. Thallus thin. Perithecia dimidiate; paraphyses scanty or none.
    Dark. Peri. hemispherical; sp. 18–22 μ × 4–5 μ. S. .... 28. A. rhyponta Massal.
    Grey or brown. Peri. elliptical; sp. 15–25 μ × 4–8 μ. Cherry. R. ...... 29. A. Cerasi Massal.
    Yellow to brown. Peri. hemispherical; sp. oblong-clavate, 20–22 μ × 5–6 μ. Alder. R. .... 30. A. Crombiei A. L. Sm.
    Yellow to brown. Peri. hemispherical; sp. linear, 16–22 μ × 4–6 μ. S. ...... 31. A. submicans A. L. Sm.

***Spores 3–7-septate.
  On trees. Thallus various. Paraphyses scanty or none.
    Th. thin, brownish-yellow. Peri. depressed; sp. becoming brown, 23–30 μ × 9–11 μ. R. 32. A. platypyrenia A. L. Sm.
    Th. thickish, granular. Sp. fusiform, 30–37 μ × 4–5 μ. Mossy tree. R. ... 33. A. chlorococca A. L. Sm.
    Th. scanty. Sp. fusiform, 11–16 μ × 3–4 μ. Trees. R. .... 34. A. desistens A. L. Sm.

119. **LEPTORHAPHIS** Koerb.—Thallus crustaceous, thin. Perithecia simple, globose or semi-globose, black, immersed; paraphyses persistent, branched and entangled; asci cylindrical, 4–8-spored; spores acicular-fusiform, straight or bent, 1-pluri-septate, colourless.

Distinguished by the form of the spores and by the more evident paraphyses. The genus is of wide distribution, but is more fully represented in tropical regions. The species all grow on trees.

Light-coloured. Sp. 1–5-septate, 20–37 μ × 3–4 μ. F. .... 1. L. epidermidis Th. Fr.
Brownish. Sp. indistinctly multi-septate, 50–80 μ × 1–2 μ. R. .... 2. L. Carrollii A. L. Sm.

120. **MICROTHELIA** Koerb.—Thallus crustaceous, immersed or superficial. Perithecia small, semi-immersed or superficial, semi-globose; paraphyses branched, entangled, sometimes mucilaginous and disappearing; asci cylindrical, clavate or pyriform, 2–8-spored; spores ovate or elongate fusiform, usually 1-septate, rarely 3–5-septate, brown.

Also a widely distributed genus. The British species are very rare, except *M. micula*, which is not common. *M. exerrans* and *M. dissepta* may be fungi parasitic on lichen thalli.

Growing on trees.	
Whitish-brown. Sp. oblong, upper cell longer, 15–25 μ × 5–7 μ	1. **M. micula** Flot.
Greyish. Sp. ellipsoid, 12–14 μ × 4–6 μ	2. **M. atomaria** Koerb.
Growing on rocks.	
Whitish, pulverulent. Sp. 2 in ascus, 25–35 μ × 10–12 μ. Cal.	3. **M. dispora** A. L. Sm.
Blackish. Sp. 10–15 μ × 3–5 μ	4. **M. exerrans** A. L. Sm.
Light-coloured, tartareous. Sp. 3-sept., 18–22 μ × 7–10 μ	5. **M. dissepta** A. L. Sm.

121. **PORINA** Ach. Thallus crustaceous, immersed or superficial. Perithecia simple, semi-immersed or superficial, the outer wall light-coloured, darkening towards the ostiole or entirely dark-coloured, entire or dimidiate; paraphyses persistent, simple; spores 6–8 in the ascus, elongate-fusiform or clavate, 2–multi-septate, rarely with a longitudinal septum in one or more cells, colourless.

FIG. 82.—*Leptorhaphis epidermidis* Th. Fr. Ascus with spores and paraphyses × 300.

FIG. 83.—*Microthelia micula* Flot. Ascus with spores and paraphyses × 300.

FIG. 84.—*Porina olivacea* A. L. Sm. Ascus with spores and paraphyses × 300.

Distinguished from *Arthopyrenia* mainly by the character of the paraphyses, but also by the more slender spores. In *P. lucens* and *P. interseptata* there is sometimes a longitudinal septum in the spores.

A. Spores septate.	
*Perithecia brightly coloured; spores 3-septate (7-sept. in *P. succina*).	
On trees.	
Thin. Peri. minute, reddish; sp. 16–23 μ × 3–5 μ. F.	3. **P. leptalea** A. L. Sm.
On peaty earth.	
Thin. Peri. reddish-brown or blackish; sp. 24–33 μ × 4–5 μ. R.	2. **P. humicolor** A. L. Sm.
On rocks.	
Thin. Peri. pale-reddish; sp. 22–32 μ × 4–7 μ. C.	1. **P. lectissima** A. Zahlbr.
Thin. Peri. amber-coloured; sp. 7-sept., 16–20 μ × 4–6 μ. R.	4. **P. succina** A. L. Sm.

**Perithecia dark-coloured; spores 3-septate.
On trees.
Thin, grey or dark. Peri. sessile; paraph. in mucus; sp. ca. 16–20 μ × 4–6 μ. C. .... 5. P. carpinea A. Zahlbr.
Thin, light-coloured. Peri. semi-immersed; paraph. free; sp. 14–21 μ × 3–4 μ. R. .... 6. P. affinis A. Zahlbr.
On rocks or soil.
Thin, brown. Peri. subglobose; sp. ca. 11–20 μ × 4–6 μ. C. .... 7. P. chlorotica Wainio.
Reddish. Cal. R. .... Var. persicina A. L. Sm.
Thin, dark. Peri. hemispherical; sp. acicular, 29–35 μ × 3–4 μ. R. .... 8. P. tenuifera A. L. Sm.
Thin, pale. Peri. hemispherical; sp. 30–37 μ × 3–7 μ. On sandy soil. R. 9. P. epigæoides A. L. Sm.
***Perithecia dark-coloured; spores 3–7- (rarely more-) septate.
On trees.
Thin, dull-brown. Peri. immersed at base; sp. clavate, 27–40 μ × 5 μ. C. 10. P. olivacea A. L. Sm.
Thin, brown. Peri. immersed at base; sp. fusiform 45–55 μ × 3–4 μ. On holly; rare .... 12. P. leptospora A. L. Sm.
On rocks or soil.
Thin, granulate, brown. Peri. innate; sp. 31–33 μ × 6 μ. On mossy ground; Ben Lawers .... 13. P. furvescens A. L. Sm.
Thickish, dirty-white. Peri. in tubercles; sp. 50–67 μ × 11–14 μ. In caves. R. .... 14. P. insiliens A. L. Sm.
Thin, brown. Peri. immersed at base; sp. ca. 52 μ × 3 μ. R. .... 15. P. Curnowii A. L. Sm.

B. Spores with occasional longitudinal septa.
On rocks.
Thin, purplish-brown. Peri. shining; sp. clavate, 38–50 μ × 8–10 μ. F. ... 16. P. lucens A. L. Sm.
Thin, purplish-brown. Peri. shining; sp. fusiform 24 μ × 6–7 μ. R. .... 17. P. interseptula A. L. Sm.

122. **THELOPSIS** Nyl.—Thallus crustaceous, thin or scarcely visible. Perithecia immersed or becoming prominent, with punctiform ostiole, the perithecial wall soft, light-coloured or dark; paraphyses slender, persistent, unbranched, free; asci many-spored; spores ellipsoid or elongate, 1–3-septate, rarely simple, colourless.

A small genus distinguished by the many-spored asci. In the two rare British species the thallus is indistinct.

Peri. pale-reddish; sp. 3-sept., 10–17 μ × 5–8 μ. Trees .... 1. Th. rubella Nyl.
Peri. black; sp. 3-sept., 14–18 μ × 4–7 μ. Mossy ground .... 2. Th. melathelia Nyl.

123. **PYRENULA** Ach.—Thallus crustaceous, superficial or immersed. Perithecia simple, variously globose, with poriform or slightly beaked ostiole; paraphyses slender, distinct; spores 8 in the ascus, elongate-ellipsoid, 2–5-septate, the spore cells lentiform or angular in shape, brown.

Distinguished by the brown septate spores and more especially by the form of the spore cells. The single British species is common on trees and of very wide distribution.

Thallus smooth, greyish-brown. Peri. prominent; spores 14–23 μ × 6–9 μ.................. P. nitida Ach.
Peri. smaller, more immersed............... Var. nitidella Mudd.

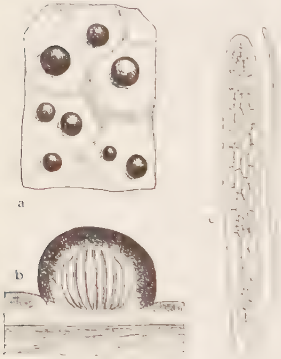


Fig. 85.—*Thelopsis rubella* Nyl.
a. Portion of plant on bark × ca. 12. b. Vertical section of perithecium × 50. c. Ascus with spores and paraphysis × 300.

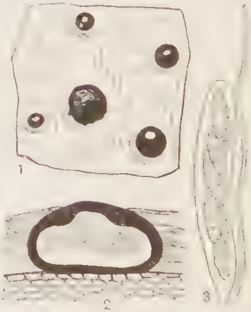


Fig. 86.—*Pyrenula nitida* Ach.
1. Portion of plant on bark × 10. 2. Vertical section of perithecium × 40. 3. Ascus with spores and paraphysis × 300.

124. **ANTHRACOTHECIUM** Hampe.—Thallus crustaceous, superficial or developed within the substratum. Perithecia simple, scattered or coherent, more or less immersed, globose or somewhat angular, entire; paraphyses unbranched, free; spores 1–8 in the ascus, elongate or ellipsoid, brown, muriform, the cells containing lentiform or angular guttæ.

A corticolous, tropical and subtropical genus. Only one species has been found in Europe, in S.W. Ireland, on hazel.

Peri. large, globose; sp. 8 in the ascus, ellipsoid, 50–110 μ × 20–40 μ........................ A. hibernicum A. L. Sm.

Family XXX. THELOCARPACEÆ.

Horizontal thallus wanting. Algal cells Protococcaceæ. Perithecia superficial, surrounded by a thalline sheath, completely enclosed or opening by a pore; asci with numerous simple or septate spores. Spermogones unknown.

A peculiar family represented so far by one genus, *Thelocarpon*.

125. **THELOCARPON** Nyl.—Thallus of small scattered or congregate verrucæ, each one enclosing a perithecium. Perithecia almost globose, completely enclosed or opening above by a pore; perithecial wall colourless, slightly developed; paraphyses slender, simple or branched or wanting; asci elongate, clavate or ventricose-fusiform, many-spored; spores minute, colourless, simple or pseudo-septate.

The species of *Thelocarpon* are of rare occurrence in this country. The minute tubercles constituting the thallus are yellowish-green; the asci are broad below, tapering upwards or somewhat cylindrical (*Th. epithallinum*). They occur in W. or Central England.

FIG. 87.—*Anthracothecium hibernicum* A. L. Sm. Ascus with spores and paraphyses × 300.

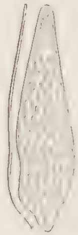


FIG. 88.—*Thelocarpon Laureri* Nyl. Ascus with spores and paraphysis × 300.

Sp. 2·5–4 μ × 1·5–2 μ. Old rails and burnt ground	1. Th. Laureri Nyl.
Sp. 3·5–5 μ × 2 μ. Rotten wood and old leather	2. Th. intermediellum Nyl.
Sp. 9–12 μ × 4–5 μ. Earth and decaying hepatics	3. Th. superellum Nyl.
Sp. 6–7 μ × 2–2·5 μ. On *Bæomyces rufus*	4. Th. epithallinum Leight.

FAMILY XXXI. TRYPETHELIACEÆ.

Thallus crustaceous, superficial or immersed. Algal cells *Trentepohlia*. Perithecia united in a pseudostroma, each with a separate ostiole; spores 2–8 in the ascus, septate, colourless or brown.

A tropical or subtropical family represented in the British Isles by one genus, *Melanotheca*.

126. **MELANOTHECA** Fée.—Thallus forming spots on the bark of trees, or scarcely visible. Perithecia in confluent groups, the inner dividing walls more or less distinct, the upper common wall black; paraphyses confused or distinct; asci usually 8-spored; spores elongate, 1- many-septate, colourless or coloured.

Peri. many in roundish stroma; sp. 3-sept.,
becoming brownish, 23–27 μ × 7–10 μ. C. 1. M. gelatinosa Nyl.
Peri. several in stroma; sp. 1-sept., brown,
22–26 μ × 5 μ. R. .... 2. M. diffusa Leight.
Peri. 2–4 in a stroma; sp. 1-many-septate,
colourless, 60–115 μ × 1–2 μ. R. .... 3. M. ischnobela Nyl.

Family XXXII. MYCOPORACEÆ.

Thallus crustaceous, superficial or immersed. Algal cells *Palmella* or *Trentepohlia*. Perithecia compound, several united in a common outer dark-coloured wall (peridium), but with separate ostioles; spores 6–8 in the ascus, variously septate, colourless or coloured.

A small family containing only two genera.

Algal cells *Palmella*........................ 127. **Mycoporum.**
Algal cells *Trentepohlia* .... 128. **Mycoporellum.**

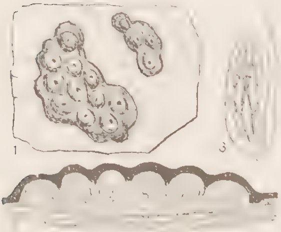


Fig. 89.—*Melanotheca gelatinosa* Nyl.
1. Plant on bark × 15. 2. Vertical section of perithecia × ca. 65. 3. Ascus with spores and paraphysis × 300.

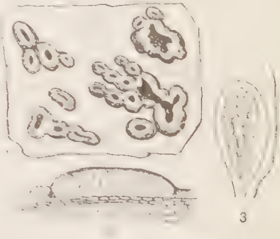


Fig. 90.—*Mycoporellum obscurum* A. L. Sm.
1. Plant on bark × 10. 2. Vertical section of perithecia × 50. 3. Ascus with spores and paraphysis × 300.

127. MYCOPORUM Flot. Thallus thin or obsolete. Algal cells *Palmella*. Perithecia not well distinct from each other; asci elongate or pyriform, ellipsoid; paraphyses entangled or disappearing; spores 6–8 in the ascus, colourless, or dark-coloured, variously septate or muriform.

Peri. 2–6 in a common peridium; sp. 3–5-sept.
and muriform, 15–18 μ × 5–8 μ. Trees. F. 1. M. miserrimum Nyl.
With less developed spores, 12–16 μ × 6–8 μ.
Alder. R. .... 2. M. ptelæodes Nyl.

128. MYCOPORELLUM A. Zahlbr. Thallus thin or obsolete. Algal cells *Trentepohlia*. Perithecia not well distinct from each other; spores 8 in the ascus, colourless or brownish, elongate, septate.

Sp. oblong-clavate, 3-sept., upper cell largest,
15 μ × 5 μ. Trees. R. .... 1. M. obscurum A. L. Sm.
Sp. ovoid, 1-sept., 18–22 μ × 7–10 μ. Holly;
in S.W. Ireland.................................... 2. M. sparsellum A. L. Sm.

GLOSSARY

Acervulate, in small heaps.
Acicular, slender, needle-like.
Acrogenous, borne at the tips.
Acuminate, tapering gradually to a point.
Adnate, adherent.
Adpressed, appressed, lying flat.
Æruginose, blue-green, like verdigris.
Agglutinate, glued together.
Aggregate, crowded but not confluent.
Amorphous cortex, the cortical hyphæ swollen and indistinct.
Amphithecium, the thalline margin surrounding the apothecium.
Apothecium, open or disc-shaped fructification.
Applanate, flattened or horizontally expanded.
Archilichenes, lichens of which the gonidia are Chlorophyceæ (bright- or yellow-green).
Ardella, the small spot-like apothecium of Arthoniaceæ.
Areola, areolate, a small space marked out on the surface of the thallus.
Arthrosterigma, septate sterigma (spermatiophore).
Ascospores, spores developed in an ascus.
Ascus, enlarged cell in which the spores are developed.
Ascyphous, without scyphi.

Biatorine, apothecia that are soft or waxy, often brightly coloured and without a thalline margin, as in *Biatora*.
Bullate, blistered.
Byssoid, slender, thread-like, as in the old genus *Byssus*.

Cæspitose, growing in tufts.
Calcareous, containing lime.
Calcicolous, living on lime rocks.
Carbonaceous, black, like charcoal.
Cariose, Carious, decayed.
Cephalodia, abnormal developments upon or within the thallus, usually inducing irregular outgrowths which contain a blue-green alga.
Chondroid, hard and tough, like cartilage.
Chrysogonidia, yellow algal cells (*Trentepohlia*).
Cilium, Ciliate, marginal hair on thallus or fruit.
Conceptacle, cavity containing reproductive cells.
Concrete, closely adhering.
Coriaceous, leathery.
Corneous, Corniculate, horny.
Corticate, covered with a continuous layer of hyphal tissue.
Corticolous, living on the bark of trees.
Crenate, Crenulate, with rounded notches on the margin.
Crispate, curled and twisted.
Cristate, crested.
Crustaceous, thin closely adhering thallus.
Cucullate, hooded or hood-shaped.
Cyphella, minute cup-like depression on the under surface of the thallus (*Sticta*, etc.).

Dendritic, having a branched appearance.
Determinate, with a definite outline.
Dimidiate, term applied to the perithecium when the outer wall covers only the upper portion.
Discoid, disc-like.
Discrete, separate, loose, term applied to paraphyses.

Effigurate, having a distinct form or figure. See placodioid.
Effuse, indeterminate spreading thallus.
Elliptical, Ellipsoid, oblong with rounded ends.
Endogenous, internally produced.

Entire, term for continuous wall of the perithecium.
Epiphlœodal, thallus growing on the surface of the bark.
Epithecium, layer covering the thecium or hymenium (best seen in section).
Eroded, erose, as though bitten or gnawed
Erumpent, immersed then bursting outward.
Excipulum, tissue surrounding the fruit.
Exogenous, externally produced.

Farinaceous, Farinose, with a mealy surface.
Fasciculate, growing in a bundle or cluster.
Fastigiate, with branches parallel, clustered and erect (Fastigiate cortex).
Fibrillæ, Fibrillose, minute fibre-like strands.
Filamentous, slender, thread-like.
Filiform, extremely slender, thread-like.
Fimbriate, fringed.
Flaccid, flabby, limp.
Flexuose, Flexuous, wavy.
Foliaceous, flat and leaf-like.
Foveolæ, Foveolate, pitted.
Fruticose, Fruticulose, having the thallus attached by a single basal point, the fronds cylindrical, filamentous or strap-shaped.
Furcate, forked.
Furfuraceous, scurfy.
Fusiform, Fusoid, elongate and tapering towards each end like a spindle.

Geniculate, bent like the knee.
Gibbous, with hump-like swellings.
Glabrous, with a hairless surface.
Glaucous, sea-green or greyish-blue like the bloom on plum or cabbage.
Glebulose, with rounded elevations on the thallus.
Gonidium, green algal cell, constituent of the lichen-thallus, term given to bright-green (Chlorophyceæ) and to blue-green (Myxophyceæ) algæ.
Gonimium, term given to blue-green algal cells (Myxophyceæ) in the thallus.
Granular, with rough irregular granules.
Granulate, with smooth granules.
Granulose, with minute granules, almost powdery.
Graphideine, resembling the genus *Graphis*.
Guttæ (guttulate), oil-drops in spores or hyphæ.

Halonate, surrounded by an outer circle.
Heteromerous, fungal and algal constituents in definite strata in the thallus.
Homoiomerous, fungal and algal constituents more or less mixed in the thallus.
Hymenium, the layer of tissue in the apothecium, consisting of asci and paraphyses, *cf.* thecium.
Hypha, a fungal filament.
Hypophlœodal, term applied to thallus growing within the bark.
Hypothallus, the undergrowth of thalline hyphæ often visible at the edge of the thallus.
Hypothecium, the layer below the thecium or hymenium.

Imbricate, overlapping like the tiles on a roof.
Immarginate, without a margin.
Incised, cut sharply into the margin.
Innate, embedded in the thallus.
Inspersed, interpenetrated with granules.
Intricate, entangled.
Isidium, Isidioid, coral-like outgrowth on the lichen-thallus resembling the old genus *Isidium*.

Jointed, septate.

Lacerate, torn or irregularly cleft.
Lacinia, Laciniate, slender thalline lobes.
Lacuna, Lacunose, depressions or holes.
Lateral, on or near the edge of thallus or fruit.
Lecanorine, term applied to apothecia with a thalline margin, as in *Lecanora*.
Lecideine, apothecia that are carbonaceous, dark-coloured, and without a thalline margin, as in *Lecidea*.

LENTICULAR, LENTIFORM, lentil- or lens-like.
LEPROSE, mealy or scurfy like the old genera *Lepra* and *Lepraria*.
LIGNICOLOUS, growing on wood.
LIRELLA, long narrow apothecium of Graphideæ.
LOBATE, thallus divided into lobes.

MACULAR, applied to a thallus occurring in spots.
MARGINAL, situate on the edge or margin.
MARGINATE, having a margin.
MAZÆDIUM, powdery fructification of Coniocarpineæ.
MEDULLA, loose hyphal layer in the interior of the thallus.
MONOPHYLLOUS, one-leaved.
MULTI-, Latin prefix, signifying many.
MURIFORM, term applied to multicellular spores divided like wall-masonry.
MYCELIUM, aggregate of fungal hyphæ.

OBSOLETE, rudimentary or wanting.
ORBICULAR, flat, with a circular outline.
OSTIOLE, opening in the perithecium through which the spores escape.
OVAL, OVATE, OVOID, egg-shaped.

PALMATE, lobed in a finger-like manner.
PANNIFORM, PANNOSE, felted.
PAPILLA, a small protuberance.
PAPULOSE, beset with papillæ.
PARAPHYSIS, sterile filament in the hymenium.
PARATHECIUM, layer surrounding the thecium (hymenium).
PATELLA, PATELLATE, sessile marginate apothecia, saucer-like.
PELTATE, orbicular, like a shield or target.
PERIDIUM, outer wall of perithecium.
PERIPHERY, PERIPHERAL, the edge.
PERIPHYSES, filaments rising near the ostiole.
PERITHECIUM, roundish fructification closed or with an ostiole, containing ascospores.
PERVIOUS, referring to scyphi that are open or perforate at the base.
PHYCOLICHENES, lichens with Myxophyceæ.
PLACODIOID, referring to an orbicular, adpressed thallus, lobed at the circumference.
PLEUROGENOUS, borne laterally on stalk or hypha.
PLICATE, folded in plaits.
PODETIUM, the secondary, stalk-like thallus of Cladoniaceæ.
POLARILOCULAR, POLARI-BILOCULAR, two-celled spores with a thick septum, and with a connecting tube between the cells.
POLYPHYLLOUS, many-leaved or -lobed.
PROPER MARGIN, the rim or margin formed of hyphæ that encircles the apothecium, *cf.* parathecium.
PRUINA, PRUINOSE, powdery bloom on the surface of thallus or fructification.
PSEUDOSTROMA, not a true stroma structure.
PYCNIDIUM, roundish fructification closed or with an ostiole, containing stylospores.

RADIATE, spreading outward from a centre.
RECEPTACLE, base or surrounding tissue of the apothecium.
RHIZINA, root-like strands.
RIVULOSE, having sinuate channels or lines.
RUGOSE, wrinkled.

SAXICOLOUS, growing on rocks or stones.
SCYPHUS, cup-like widening of the podetium in Cladoniaceæ.
SEPTATE, divided by a cell-wall.
SEPTUM, wall dividing one cell from another.
SILICOLOUS, growing on rocks containing silica.
SINUATE, with a deep wavy margin.
SMARAGDINE, emerald or dark bluish-green.
SPERMATIUM, spore-like body formed in the spermogone.
SPERMOGONE, closed fructification containing spermatia.
SPORE, reproductive body which becomes free and germinates to form a new plant.
SQUAMULE, a small thalline lobe.
STERIGMA, the stalk from which the spermatia are abjointed.

Stratum, a layer of tissue.

Stroma, hyphal structure in which fructifications are developed.

Symbiont, one of two dissimilar organisms living together.

Symbiosis, a living together of dissimilar organisms.

Tartareous, resembling tartar, having a more or less rough crumbling surface, or thickish and almost smooth.

Terricolous, living on soil.

Thallus, vegetative part of the lichen-plant.

Thecium, the hymenium (asci and paraphyses).

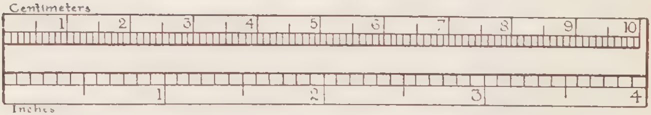
Thyrsoid, with crowded dichotomous branching.

Trabeculæ, reticulating fibrils.

Turgid, swollen.

Urceolate, pitcher-like, hollow and contracted at the mouth.

Verruca, a granular wart-like part of the thallus.



Comparative scale, showing centimeters and inches.

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CORRECTIONS

Page 54, line 15, *for* Andrewsii *read* Andrewi.
,, 54, line 8 from bottom, *after* subimbricata *for* Th. Fr. *read* A. L. Sm.
,, 60, bottom line, *insert* A. Zahlbr. *after* ericetorum.
,, 62, half-way down, *for* opthalmiza *read* ophthalmiza.
,, 65, lines 9 and 8 from bottom, *for* actinostoma *read* actinostomus; and *for* cæsioplumbea *read* cæsioplumbeus.
,, 67, half-way down, *for* artica *read* arctica.
,, 79, line 23 from bottom, *for* Fée *read* Fr.
,, 79, line 21 from bottom, *for* Fr. *read* Fée.
,, 99, Fig. 52, *for Bacidia rubella* Massal. *read Bacidia luteola* Mudd.
,, 101, line 19, *insert* Koerb. *after* leptocline.

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